JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JUNE, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Details of some Experiments upon the Comparative Strength of Trussed and plain girders of wood, made at the Philadelphia Exchange, during the construction of that building in 1832. *By* Mr. John McClure and Ellwood Morris, C. E. *Reported by the latter.*

The experiments which have been made upon the relative strength of girders, trussed and untrussed, are so few—that the following details may be found interesting to persons engaged in construction; particularly as the mode of trussing by suspension, therein tested, is becoming more and more extensively used in this country, and is really susceptible of being made very serviceable in many situations.

These experiments were undertaken with the view of ascertaining the proximate value of wrought iron suspension trusses for girders, which were about that time brought forward conspicuously here, as a new and useful improvement in carpentry; though at least in one instance they had been used many years before in this country; viz., by Lewis Wernwag, the celebrated carpenter,* who applied suspension bars, one and a quarter inches square, to stiffen the main longitudinal floor beams of the bridge over the Neshaminy creek, in this state, which was built by him in the year 1808. (See the annexed sketch

* Mr. Wernwag, a German by birth, immigrated here in 1788, and is the same mechanic who designed and constructed the famous timber bridge of 340 feet span, over the Schuylkill river at Philadelphia, (recently destroyed by fire,) besides many other wooden bridges of magnitude and importance, in various parts of the United States.

which represents a side view of the suspension truss used in the bridge referred to.)

We have taken the pains to ascertain from Mr. Wernwag himself, the date of the construction of the Neshaminy bridge, as it carries the application of the suspension girder truss somewhat further back into past time, than has heretofore been expected; though the writer has lately been informed by a gentleman distinguished for his antiquarian researches, that such trusses were in use upon the continent of Europe even antecedent to that time.

The now recorded history of the wrought iron suspension truss for girders, as far as known to the writer, is as follows:—"In 1821, Mr. R. Stevenson, of Edinburgh, designed a bridge for the river Almond, in which the principle of supporting a roadway by iron bars passing underneath, was first adopted."* In 1822 the same principle was recommended by Mr. H. Palmer, to be applied in carrying his railway, of a single line, over streams or vallies.† In 1824 Mr. A. Ainger submitted a suspension trussed girder to the Society for the encouragement of Arts;‡ to which we shall presently more particularly refer, and which was successfully applied to practice. In 1828 girders trussed by suspending rods were used with manifest advantage in several buildings, by Mr. Joseph Conder, who claimed the merit of their invention, as did also Mr. A. H. Renton, Civil Engineer.‖ All these gentlemen, however, without their knowledge, had been anticipated in this matter by Wernwag, at the Neshaminy bridge, as before mentioned.

In addition to the above, the writer may state that in 1833 he examined a wrought iron suspension truss, which had been applied some years before, on a large scale, to uphold the central parts of Flat Rock bridge, (of 198 feet span,) over the Schuylkill river; which bridge—constructed with *very slender* curved ribs of three inch plank —had at that time yielded considerably, and since has fallen down. In 1834 he measured a horse bridge (built by Wernwag) upon the Chesapeake and Ohio Canal, near Harper's Ferry, of 52 feet span, which was trussed like fig. 1, the horizontal bar being 26 inches clear of the underside of the outer floor beams, which rested each upon two inverted queen posts of iron, diagonally braced against lateral motion,

* Civ. Eng. & Arch. Jour., for Oct., 1841. "Description of the Foot Bridge over the river Whitadder, at Abbey St. Bathans, Berwickshire; by J. R. Wilson."

† Palmer's "Description of a railway on a new principle," London.

‡ Journal of the Franklin Institute for 1832. ‖ Reg. of Arts, 2nd series, vol. ii, London.

and rising, as it were, from the angular points *b* and *c*. This species of truss has, since that time, been applied to strengthen the girders of a number of bridges in this country, to which it is unnecessary now to refer.*

Returning from this digression, into the recent history of suspension trussing; we will now repeat, that in this Journal for August, 1832, the description of a mode of trussing girders with wrought iron rods, acting upon the suspension principle, was extracted from the "Transactions of the Society for the encouragement of Arts," and accompanied by two wood engravings.

The plan alluded to was devised by Mr. Alfred Ainger, and submitted to the Society in 1824, who after investigating the merits of the plan—trying some experiments upon models—and witnessing its successful application in buildings—finally testified to Mr. Ainger, their sense of the merit of his contrivance for strengthening beams, by formally awarding to him the thanks of the Society.

Mr. Ainger's suspension truss, as applied to a girder of 34 feet span, and described in this Journal for 1832, consisted of two sets of iron rods, (one on each side of a single beam of timber,) secured by screws and nuts, to abutment plates, notched upon *the upper side* at the ends; these rods descended so low as to admit of two supporting plates being inserted between them and the beam, and forced up against its underside by the end screws, so as to give to the girder two intermediate points of support; thus dividing the whole span into three bearing spaces of equal extent; the side view closely resembling fig. 1.

This girder is described as having answered very well, it is stated to have carried a leaden flat for two years, without sensibly altering its form.

Mr. Ainger also recommended that notches should be cut in the upper side of the beam extending to one-third of its depth, and filled "with thin wedges of hard wood or metal, forcibly driven in," so as to augment its strength and stiffness, by putting its upper side in a state of compression before being loaded.†

* In connexion with this branch of the subject, we must not omit to add the following, from the same paper of Mr. J. R. Wilson, (Civ. Eng. & Arch. Jour., Oct, 1841,) already quoted.

"In 1833 a bridge was erected on the tension bar principle over an arm of the lake of Geneva. It has 13 openings, of 55 feet span, and is 25 feet broad. The same plan has been adopted for two foot bridges of 138 and 81 feet span respectively, erected several years since over the river Ness, near Inverness; and also for a bridge over the river Whitadder, in Berwickshire, at Hutton Mill, designed by Mr. Jardine, of Edinburgh, which consists of three openings of 50 feet span. Mr. Smith, of Deanston, has erected a foot bridge of this kind, 103 feet span, near Doune: and has also applied tension rods very successfully, for supporting the floors of Deanston cotton works, where they have been in use for many years."

† This was conformable to the results of some experiment by M. Duhamel, who showed

It was the article above referred to which first drew the attention of the writer to this particular subject, and induced him, in company with Mr. McClure, to undertake, in the year 1832, a few experiments upon model girders.

These models were accurately made under the direction of Mr. McClure, and were *five in number;* each was composed of two parts, or flitches, so united as to bear a strain together; each side, or flitch, was 53 inches long, 1.75 inches deep, and 1.16 inches broad, having together a sectional area of 4.06 superficial inches; and all the models were made of clean, straight grained, and well seasoned *white pine;** number 1, 2, and 3, were from the same plank, and Nos. 4 and 5 from timber of the same lot and quality.

Model No. 1: Was trussed in a mode similar to that prescribed by Mr. Ainger; a single wrought iron rod exactly one-fourth of an inch square, being secured upon the upper side, at both ends, by quarter inch square pins, resting horizontally upon abutment plates one-twelfth of an inch thick, which embraced each end of the girder; this rod descended between the flitches so low as to admit the insertion of two bearing plates, *b* and *c*, fig. 1, which were forced in between it and the underside of the beams, at equal distances from the ends, and from each other, so as to give to the girder a small camber. (See plan and section, fig 1.) And, in addition, 34 equidistant cuts were made in this model, to a depth of one-third of the whole, and tightly filled with thin pieces of hard oak well driven in.

Model No. 2: Was similar to No. 1, (fig. 1,) in all respects except that the hard oak wedges were *omitted.*

Model No. 3: Was a plain stick, formed by nailing the two flitches

that when a bar of *soft wood*, such as willow, was cut one third through from the upper side, and this cut filled with a thin piece of *hard wood* stuck in pretty tight, *its ultimate transverse strength was thereby increased about ten per cent.*, (Barlow's Essay on the Strength and Stress of Timber, 3rd Ed., 1826.)

* This is the *Pinus Strobus* of Michaux's North American Sylva (vol. iii, p. 159)—the loftiest tree of the American forest—it is employed here for an immense variety of purposes, and is one of the most valuable timbers which we possess.

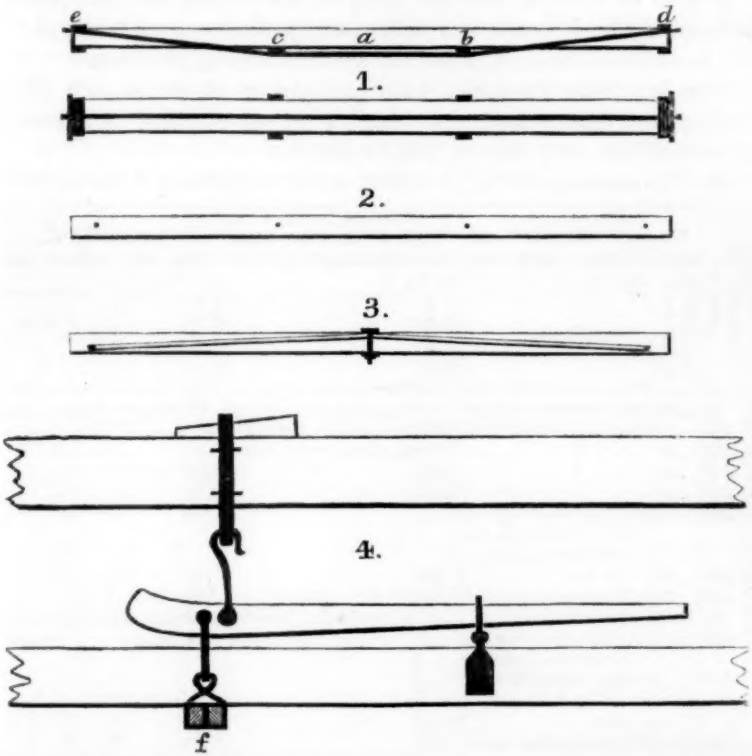
It is the wood called *Weymouth Pine*, in Tredgold's Carpentry; and we may here remark that the concurrence of three of our experiments indicates that the ultimate strength of the white pine, used in our models—which was of the best quality supplied by the lumber market of Philadelphia—did not exceed 868 lbs., for sticks of the scantling, and length of bearing, used by us.

Wherefore the constant quantity *c*, of the table in Tredgold's Carpentry, (2nd Ed., London, 1828, p. 56,) calculated by the formula $c = \frac{W\,L}{b\,d^2}$ would be 509 instead of 658, as Tredgold has it, which last is certainly too high a number; for the breaking weight of our plain stick, (model No. 3,) if calculated by it, would have been 1,122 lbs., instead of 868 lbs., (as we actually found it to be,) *or thirty per cent. more.*

together, side by side, with four nails in the centre line, (see fig. 2, side view.)

Model No. 4: Was a girder trussed exactly like Nos. 1 and 2, except that *a central bearing plate*, one-sixteenth of an inch thick, was inserted between the beam and truss rod at *a*, fig 1.

Model No. 5: Was a girder trussed in the common way—with one king bolt, two iron abutments, two hard oak braces let into each flitch nearly one eighth of an inch—and keyed up to a slight camber. (See fig. 3, which shows the girder with one flitch removed.)



All of these models were put under strain in the same manner, their own weight being counterbalanced; viz., by resting them against two fixed supports, exactly 50 inches asunder, and applying the straining force, by a vertical pull upwards, through an iron stirrup with rounded edges, slipped over the model—which was turned bottom up—and attached to the shorter arm of an accurate steelyard, which weighed up to 1,288 lbs.; and the successive strains were put on by moving the pea of the steelyard, as in weighing, so as to add usually 56 lbs.

at a time; the beam of the steelyard being adjusted to a level at each addition of strain, and the deflections being carefully measured—from a fine string joining the extremities of the models—by a diagonal scale to hundredths of inches. (See fig. 4, which gives a general idea of the experimental apparatus, *f* being a girder under trial.)

The subjoined tabular statement exhibits, at one view, the results of the trials of the strength of the several model girders; which it will be recollected, were all of precisely the same scantling and bearing length.

It must be observed that our steelyard not having sufficient power to break model No. 4, it was subsequently broken by a lever, in order to ascertain the position of *the neutral axis of fracture.*

The five following results were common to all the models when broken, and though similar to what have been observed by other experimentalists, they may as well be stated.

1. *The neutral axis of fracture*, occupied precisely the same place

Statements.	Weight applied in pounds.	Girder No. 1. Trussed with iron rod, and wedged along compressed side. See fig. 1.		Girder No. 2. Trussed with iron rod, but without the wedges of No. 1. See fig. 1.		Girder No. 3. Plain stick without trusses. See fig. 2.	
		Deflection in inches.	Remarks.	Deflection in inches.	Remarks.	Deflection in inches.	Remarks.
1	56	c.20	Original camber .31ins	c.15	Original camber .20ins	.09	Original camber .0 ins.
2	112	c.06	Stood level with 140lbs	c.09	Cambers marked c.	.16	
3	168	.09		.00	Stood level with 168lbs	.27	
4	224	.22		.04		.37	
5	280	.40		.12		.47	
6	336	.55	364 lbs. remaining on for 10 minutes, increased the deflection .12 ins.	.19		.57	
7	392	.80		.28		.65	
8	448	.94	At 8 unloaded returned	.37		.75	
9	504	1.13	to a camber of .10.	.47	At 9 unloaded returned	.83	At 9 unloaded returned
10	560	1.40	532 lbs. remaining on 5 minutes increased the deflection from 1.27 to 1.32 = 0.15 ins.	.64	to a camber of .12ins	.93	Ditto. [to level.
11	616	1.68	At 11 unloaded return-	.77		1.07	
12	672	1.98	ed to a deflection of	.89	Upper fibres begin to	1.19	Upper fibres begin to
13	728	2.21	.18 ins.	1.00	crush.	1.35	crush.
14	784	2.50		1.20	Appearance of crush-	1.51	Crushing fast increas-
15	840	2.80		1.50	ing extends rapidly.	1.76	ed.
16	868	3.00	Broke with 868lbs. (or	1.75	Broke with 868lbs. (or	2.50	Broke with 868lbs. (or
17	896		7 cwt. 3 qrs.) ulti-		7 cwt. 3 qrs.) ulti-		7 cwt. 3 qrs.) ulti-
18	952		mate deflection 3		mate deflection 1¾		mate deflection 2½
19	1008		inches.		inches.		inches.
20	1064						
21	1120						
22	1176						
23	1232						
24	1288						

in all, being at four-sevenths of the whole depth down from the top, or one fourteenth below the middle, (Barlow's experiments on *fir beams* fixed it at five-eighths of the depth, which is nearly the same.)

Giving, area of fibres *crushed*,	2.32	square inches.
Ditto *torn asunder*	1.74	"
Total sectional area in superficial inches	4.06	

2. The first indications of fracture, always appeared on the upper side, by the fibres *crushing*.

3. The signs of crushing at the time of fracture could be traced each way from the centre some five or six inches.

4. The deflections within the limit of elasticity, were (very nearly) equally increased by the addition of equal weights.

5. The place of the neutral axis of fracture, was most distinctly marked in every case, and the section of fracture, in all the models,

Statements.	Weight applied in pounds.	GIRDER No. 4. Trussed like Nos. 1 and 2, but with the addition of a *centre plate* at *a*. See fig. 1. Deflection in inches.	Remarks.	GIRDER No. 5. Trussed with wood in the common way. See fig. 3. Deflection in inches.	Remarks.
1	56	c. 14	Original camber .19 inches.	.05	Original camber .05 inches.
2	112	c. 09	Cambers marked *c*.	.10	Stood level with 28 lbs.
3	168	c. 05		.17	
4	224	.00	Stood level with 224 lbs.	.25	
5	280	.04		.32	
6	336	.08		.41	
7	392	.14		.47	
8	448	.21		.55	
9	504	.29	At 9 unloaded returned to the original camber.	.64	
10	560	.37		.71	
11	616	.46		.79	At 11 unloaded returned to level.
12	672	.53		.95	
13	728	.61		1.02	
14	784	.69		1.12	At 14 unloaded returned to level.
15	840	.77		1.18	
16	868	.82	At 16 (the breaking point of Nos.	1.25	
17	896	.87	1, 2, and 3,) unloaded returned	1.46	At 17 considerable signs of crush-
18	952	.92	to a camber of .08 ins., and exhibited no signs of fracture.	1.61	ing appear.
19	1008	1.00	At 19 unloaded returned to a slight	1.76	
20	1064	1.10	camber, though signs of crushing	2.07	At 20, splinters on the underside.
21	1120	1.21	begin to appear.	2.50	Weights briskly added, fracture
22	1176	1.40		3.00	takes place at 22, ultimate de-
23	1232	1.56	Signs of crushing increase.		flection 3 ins. Breaking weight
24	1288	1.75	Rested here for want of weight, and unloaded returned to a permanent deflection of .16 ins.		=10½ cwt.

very closely resembled that shown in Plate III of Barlow's Essay on Timber, 3rd ed: London, 1826.

The elastic strength of Model	No. 1,	did not exceed	392 lbs.
do.	No. 2,	do.	560
do.	No. 3,	do.	560
do.	No. 4,	do.	1120
do.	No. 5,	do.	840

As indicated by the breaking weights, excepting only No. 4, which would have borne a few more pounds; and No. 5, which would have broken with less, *if time* had been allowed.

The ultimate strength of Model	No. 1,	was	868 lbs.
do.	No. 2,	"	868
do.	No. 3,	"	868
do.	No. 4,	"	1288+
do.	No. 5,	"	1176—

A comparison of the tabular results will show:

1. That, contrary to the experiments of Duhamel, wedging the stick upon the upper side to one-third of the depth, with slips of hard wood—at least in the extent to which we carried it—neither augmented nor impaired *the ultimate strength* of the timber, while it diminished its *stiffness.*

2. That the suspension truss, though it added to the *stiffness*, had no effect whatever, upon the *ultimate strength*, when only *two bearing plates*, (as *b* and *c*, Fig. 1,) were used, and the weight applied midway between them.

The reason of this appeared to be, that the deflection between the bearing plates, when added to the compression of the timber, at these, and at the abutments, allowed the beams to bend enough to exceed the deflection due to their elastic strength, before the suspension truss came fairly into action.

3. That the suspension truss, *with a centre plate* applied at *a*, Fig. 1, *doubled the elastic strength* of a plain girder of the stated dimensions, *and added near fifty per cent. to its ultimate strength.*

4. That trussing a girder with hard wood, in the usual manner, increased its *elastic strength* fifty per cent., and its *ultimate strength* about thirty-five per cent.

This last conclusion is nearly the same as that developed by Professor Barlow, in experimenting upon a similar truss. (See Treatise on the Strength of Materials: London, 1837, page 165.)

The experiments referred to, and of which we subjoin a synopsis, showed that though there was no efficacy at all, in a common girder truss, *of three pieces of hard wood, with queen bolts*,—indeed, that it was weaker than an untrussed stick,—still, the truss of *two pieces*,

with a king bolt, similar to that of Fig. 3, ***did add considerably to the strength.***

Synopsis of Barlow's Experiments on the Strength of Girders of Wood.

No. of Experiment.	Distance betw'n the Props, in inches.	Depth of the Girder, in inches.	Breadth of the Girder, in inches.	Ultimate weight imposed, in pounds.	Ultimate deflection, in inches.	REMARKS.
1	68	2	$1\frac{7}{8}$	500	2.25	*Trussed*—not broken.
2	68	2	$1\frac{7}{8}$	500	1.55	*Untrussed*—not broken.
3	50	2	$1\frac{7}{8}$	953	+1.50	*Trussed*—broken.
4	50	2	$1\frac{7}{8}$	717	+1.00	*Untrussed*—broken.

Nos. 1 and 3 were trussed conformably to Plate 39 of Nicholson's Carpenters' New Guide, the former being a model of a girder of thirty-four, and the latter of twenty-five, feet span.

No. 1 was *a queen bolt truss, of three pieces;* No. 3 was *a king bolt truss of two pieces,* similar to Fig. 3, and the weights were applied in the centre, or over the angular point of the latter truss, and midway between the queen bolts of the former.

Hence it appears that whilst the queen bolt truss, No. 1, was actually weaker than the untrussed stick No. 2, the king bolt truss No. 3 was *thirty-three per cent. stronger* than the untrussed stick No. 4, of the same dimensions, and similarly strained.

Our experiments on model No. 5, which was trussed nearly in the same manner as Barlow's No. 3, display *an augmentation of strength of thirty-five per cent.* over that of an untrussed beam.

The close agreement of our results with those of Barlow, probably justifies the declaration that—at least whilst they are new—*the common wooden king bolt trusses, add one-third to the strength of the girders to which they are applied.*

Tredgold, however, in his invaluable treatise upon Carpentry, (2d Ed., London, 1828, p. 79,) says that "The methods in general adopted, (for trussing girders,) have the appearance of much ingenuity, but in reality they are of very little use." And again,—"The defects of ordinary trussed girders are very apparent in old ones, as it is not simply strength that is required, but the power of resisting the

unceasing concussions of a straining force, capable of producing a permanent derangement in a small surface at every impression."

As the tendency of time is undoubtedly to impair the efficiency of all sorts of trussing, and especially of those which—like girders trussed within their own depth—have *very obtuse supporting angles;* more extended experiments, and further observations, are necessary to settle definitively the question of strength, between beams trussed within themselves with timber, and plain sticks of the same bearing, and scantling.

In 1828, Mr. J. Conder, soon after applying in practice the suspension truss *of two angular points*, (see Fig. 1,) seems to have become satisfied that it was defective; for he soon brought forward, as a great improvement, the idea of forming the truss with but *one angular point*, like Fig. 3, inverted; and it will be remembered, that in our experiments we were unable to procure any benefit from the suspension truss, until by the central bearing plate at *a*, Fig. 1, we had, *in effect*, reduced that truss to one of *a single angular point.*

In trussing a girder, the main object is to strengthen the weakest point—which is the centre of the beam—and as Barlow's experiments upon direct *queen bolt trusses*, and our own, upon inverted, or suspension trusses, *of two angular points*, indicated that no advantage was derived from either, when strained in the middle, we are strongly disposed to conclude, that whether the truss acts by tension or by compression, it should (in most cases,) *have but one angular point.*

In support of this view, the writer may state that he has seen a number of suspension trusses of two angular points,—attached to the girders of bridges,—which, on close examination, indicated that they bore but little strain; whilst those with but one angular point, which he has had an opportunity of examining, seemed, in most cases, to be acting with much greater efficiency; this matter therefore seems to be of sufficient importance to justify our soliciting to it, the attention and consideration of professional men.

Philadelphia, April 28th, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Injudicious Policy pursued in the Construction and Machinery of many Railroads in the United States. By JOHN C. TRAUTWINE, *Civil Engineer.*

[CONTINUED FROM PAGE 316.]

The argument is not admissible, that perhaps in ten or fifteen years, the business of the road may increase to such an extent as to pay a profit on its cost. If the engineer wishes to ascertain if this be ac-

ceptable reasoning, let him suggest it to the stockholders before the road is commenced, and I suspect he will find but few to acquiesce with him.

But I see the sceptical reader elevate his eyes in astonishment. "What," says he, "the old flat bar! light engines! heavy grades! Is it possible the writer expects his readers to subscribe to so antiquated and exploded a creed as this? Even supposing his road to answer very well at first, with the limited business assigned to it, what will be done with it when the trade increases? *Ours* is a growing country, and the present business is no criterion to act on: in a few years it will have increased fifty, nay, a hundred per cent.; what is to be done then?"

The answer readily suggests itself: if the business increases 100 per cent., put on four engines instead of two. "But, ah!" says the objector, "there I have you. Don't you know that one heavy engine will draw a given amount of freight at less expense than a greater number of light ones can?" I most assuredly do know this to be true in the abstract; and I know, moreover, that a blind adherence to this "abstraction," has nearly ruined more railroad companies than one, in the United States. Let us illustrate this, also, by an example. Suppose our $ 10,000 a mile road to be finished, and in operation; its little models daily steaming it modestly over the line, with their thirty tons gross; and the stockholders annually pocketing their eight per cent. "net." This all does very well for a time; but "ours is a growing country," and soon the business on our road increases one hundred per cent. What is now to be done, is the question. One heavy engine can take all our increased freight at one load, at an annual expense for the maintenance, of but $ 5000; while on the other hand, if we employ two small engines to carry it, we incur an expense for maintenance of motive power, of some $ 9000 per annum. "Here is a pretty piece of business," say the Directors; "why did not our engineer foresee all this: here he has entailed on us an annual loss of $ 4000, at the very least. Did not experience, all the world over, show that railroads attracted new business to themselves? Did he not know that heavy engines were more economical than light ones? Did he not see that they were introducing them on all the English railroads? However, what is done cannot be helped; we have been behind the age long enough: let us try to catch up with it at last; let us order a thirteen ton engine, or rather, as the business will certainly continue to increase, let us get a twenty ton one, at once." This is accordingly done; and the "fell destroyer," this "monstrum horrendum *ingens*," is trotted out. They build a fire in him;—he snorts;—he starts;—he is off. "Ah! this is something like; now we are up

with the age." But, alas! in a few months things undergo a change. Rumors, faint at first, but gradually gaining strength, reach the Directors' ears, that something is going wrong on the road. An investigating committee is appointed; they visit the road, or rather the spot where once it stood; for the road itself has vanished: it is "*non est.*" After a long and laborious investigation, assisted by several scientific and practical gentlemen, the committee report that, first of all,—the bar was mashed into the timber;—and then—the timber was mashed into the ground. They moreover state their conviction that the flat bar has proved itself utterly unfit for railroad purposes; and suggest that as the Directors of the Liverpool and Manchester railroad have recently found it expedient to adopt an edge rail, weighing seventy-five pounds to the yard, *therefore* a similar rail should be substituted for the miserable flat bar on their road. The heavy rail is accordingly ordered, and laid down. "Now we are certainly up with the English; we have as heavy engines as they have, and as heavy rails; therefore, the road *must* pay well. We can carry sixty tons with our new engines, as easily as we could carry thirty with our old ones, and at very little more expense; that settles the matter. If the road yielded eight per cent. before, it must unquestionably yield 16 per cent. now, with double the business; and the expenses of transportation only the same as originally."

This certainly looks somewhat plausible; but it is found, notwithstanding, that somehow or other the road now don't pay at all. "What! our miserable flat bar road, and tea-kettle engine, pay eight per cent., and our edge rail, and twenty ton engines, a losing concern? How does this happen?" It happens thus: *the road has now cost too much*; eight per cent. on a road costing $ 10,000 per mile, is but four per cent. on one costing $ 20,000 per mile; and in our order to England, we omitted one very essential item to the success of heavy rails and powerful engines, and that is, a heavy trade. Now, had we, when our business increased 100 per cent., merely put on two more small engines, every thing would have worked very well; and the road would in this case have yielded sixteen per cent., instead of eight. It is true, that two heavy engines could, at an expense of maintenance of but $10,000 annually, have done the work of the four light ones, which cost annually, perhaps, $ 18,000; but in order to save this difference of $ 8,000, we must have had a road proportioned to the heavy engines; and to secure this would probably require an expenditure, the interest on which would be many times greater than the $ 8,000 saved on the engines.

The foregoing is, of course, but an imaginary case. Still it serves to illustrate the principle, or rather, *want of principle*, on which far

too many of our railroads are now being constructed, all over the Union. We see whole states falling into the error; indeed, we are falling into it, nationally.

I conceive that this mania for the *indiscriminate* use of heavy engines and rails, has done more injury to the railroad cause, than perhaps any other single consideration that has been brought to bear upon it; but "Dulce est desipere in *Loco*," appears to be the general motto, and it is probably useless to cry out against it. No position can be more tenable, more absolutely palpable, than that it is true economy to use the very heaviest engines, and best constructed road, *that the business requires.* But what constitutes a heavy business in one case, may be a very light one in another, and vice versa. The matter admits, in almost every instance, of calculations sufficiently approximate to determine the class of road, and machinery, that should be adopted; and had this expedient been resorted to on all our railroads, we should probably not have had a single one in the United States, yielding less than ten per cent. on its cost.

I sincerely trust that I shall not be accused of disaffection towards permanent railways, and heavy engines; on the contrary, I repeat emphatically, that they should be as permanent, and as heavy, as the business they are to accommodate can possibly justify. What would we think of a company who should purchase the Great Western steam packet, to ply hourly across the river at Philadelphia, with some five or ten passengers at a trip? Would we not pronounce them demented? And should they tell us that Philadelphia had gone on increasing so rapidly, and so regularly, for many years past, that they felt confident their number of passengers would increase 100 per cent. in ten or fifteen years more, would that diminish our suspicions of their insanity? But yet does it follow, because the Great Western would not be a profitable investment in this case, that therefore she is not a fine sea vessel, and admirably adapted to carry on a lucrative business between England and America? Or does it follow, that because *she* was a losing concern when running between Philadelphia and the opposite shore of the river, that therefore a first rate, substantial little steam ferry *boat* should not do an excellent business on the same route? Or, lastly, suppose that the engines of the two boats, should be respectively converted into locomotives, for accommodating precisely the same limited amount of business *on land*, does that in any degree alter the case? Is it not equally apparent in either instance, that the magnitude of the *trade*, and not of the *boiler*, must be depended on as the great prime mover of the enterprise? I certainly should consider the engineer who would advise the same character of road, and machinery, in every case, fully as deficient in

judgment as the company who should convert the Great Western into a ferry boat.

The remarks applicable to heavy engines, apply also to heavy cars. To diminish the weight of the engines, and still allow that weight to be exceeded by the cars, were evident impolicy. As before remarked, I should on our road, limit the weight on any one wheel, to one ton; and should, consequently, so proportion the cars, as that when loaded they should not exceed that limit.

We often hear the remark, nay, I presume that nine engineers in ten, throughout the profession, will yield it their unqualified assent, that the power of an engine is less on the flat bar, than on the edge rail, by some twenty or twenty-five per cent. In *strict justice*, I suspect there is no foundation for this assertion. I doubt not that an engine *adapted to the flat bar road*, will be found to exert quite as much power on it, as on the edge rail; but, unquestionably, if we place on it engines so heavy as to crush it, and deflect the timbers, a different result must follow. Indeed, it would not be difficult to conceive of an engine so heavy as to deflect the road to such an extent, as almost to deprive her of all locomotive power.

The examples assumed in the foregoing pages, have been taken at hazard, merely for the purpose of illustration; but so far as the character of road, and engines, which I have suggested, are concerned, I am of opinion that they will be found in very numerous instances, preferable to light grades, heavy edge rails, and powerful engines; particularly on the score of original expense. Roads built after this plan, will not partake so much of an experimental character, as those involving greater outlays; and, moreover, they would be adequate, under proper management, to accommodate, with perfect ease, far more trade than passes over half the roads in the Union. For example, there are few of our roads doing a business as great as could be taken at two trips daily, in each direction, by eight ton engines, over sixty feet grades. What folly is it then in such cases, to double the cost of the road for easy grades, heavy rails, and powerful engines? The arguments usually brought to bear against advocates for cheap roads is, that the business will soon increase to such an extent as to pay well on the cost of a first-rate road. This may be true in many instances, but there are more cases to which it is not applicable; for even admitting that the business did, in ten or twenty years, increase 200 or 300 per cent., it by no means follows, that even *that* amount would justify a first class road.

The engineer is not left altogether to the exercise of his discretion, or judgment, in the matter. It admits, as before stated, of an arithmetical determination, having the data of the probable amount of

trade that will be accommodated by the road. In collecting this data, he should shun alike, assumptions based upon the probable business of the road for the first day, or even week, or month, or year, of its going into operation; and thus having in view the prospective resources at the termination of the coming half century.

I will here take occasion to remark, that more, both of time and skill, will be required, to locate a railroad on the principles I have advocated, than on the ordinary plan. When, as is usually the case, the route is located, in great measure, with a view to long stretches of straight lines, easy curves, and light grades, the "modus operandi" is much less complicated, than when the engineer shall be obliged, at almost every step of his progress, to test his cuts, curves, &c., by the standard of justifiable expenditure. It is a very easy matter for the engineer to draw a long straight line on his map, and then tell his assistants to run it out; but it will be somewhat more difficult to decide on that line, between the same points, that shall best subserve the pecuniary interests of the company. In the one case, the route may be located *by miles;* in the other, it must be done *almost by inches.* Perhaps every engineer will bear me out in the assertion, that the difficulties of a proper location must be inversely as the finances of the company, should this system be adopted. As before remarked, the present plan has but little, if any, reference to that point.

I shall not attempt to follow Mr. Ellet into those cases which he supposes, in which it may become advisable to assume grades, more nearly coincident with the natural surface of the ground, and to dispense with the use of iron rails altogether; using cars no heavier than a light barouche. I may, however, be permitted, en passant, to express my entire assent to his views in that particular. Many short branches, from great thoroughfares to watering-places, or to small towns, might be constructed, and made to pay well, could we but divest ourselves of our "stereotyped" notions of what constitutes a good railroad. Witness the railways laid in coal mines: there are none more serviceable;—there are none that pay better;—yet they do not cost $ 20,000, or $ 30,000, a mile; nor do they ever feel the weight of even a *model* locomotive. How powerful an appeal do they make to us, *to proportion the means to the end.*

I will now add some further remarks in support of my views respecting the location of a line of railroad; and again let me express the hope that I shall not be misunderstood as expressing my ideas of the best *abstract* line, but of the best *paying* line;—not that on which a load can be propelled by the least expenditure of *power*, but by the least expenditure of *money;*—not that whose merits are apparent on the ground itself, but which are evidenced forth resplendently, in the

countenances of the stockholders, as they button up their pockets, on dividend day. I am fully aware of the obloquy to which an engineer exposes himself, in lifting up his feeble, and almost solitary voice, against any of the prominent evils of the day; and I am therefore the more desirous to be distinctly understood.

On nearly all our railroads, of any length, there occur at various points, maximum grades, of from thirty to fifty feet to a mile. These grades limit the capacity of the engines; and one such occurring on a road, (unless additional power be employed at that point,) does this quite as effectually as fifty would. Yet on the same road, we almost universally (perhaps *universally*,) see very great expense incurred all along the line, to secure much lighter grades, even where somewhat heavier ones would have coincided with the natural surface, and have involved little or no expense. This practice, *at least to the extent to which it is generally carried*, (for there are many exceptions,) I look upon as radically wrong.

Undulations in the acclivities of a railroad, it is admitted, must be allowed to a certain extent; but the precise limits of the expression, "certain extent," it is needless to say, have not been as yet defined. The application of the term must, of course, vary in each separate road; and perhaps its most literal interpretation, as sanctioned by practice, would be, "Such as the engineer considers the nature of the ground to require." This construction I should be willing to modify, by adding, "and the best interests of the company demand."

Admitting then, *that acclivities must occur* on the line, affecting the load of the engine, I am under the impression that the *number* of them may be increased greatly over what is customary; or, in other words, that the graded surface may be made to conform much more closely to the natural one, than is generally done; and that it would be to the interest of companies, were that system adopted. Under such circumstances, a succession of undulations, within limits not too restrictive of the speed of the engine, it is well known would involve no loss of either time, or power, injurious in practice.

It is true, that Robert Stephenson, Esq., Civil Engineer, in his report to the Directors of the London and Birmingham railroad company, on the subject of undulatory railroads, objects that the variations in speed attendant on alternate ascents and descents, would create an irregularity in the intensity of fire in the engine, which is calculated to injure their boilers by frequent expansion and contraction;—and he states, moreover, that the parts of an engine should be calculated for a certain degree of speed; and that rate maintained as regularly as practicable while on duty, in order to secure the attainment of the most effective performance. He speaks, however,

with regard to the "*undulatory system*," so called, of Mr. Badnall; and from one of his observations, I suspect that his remarks are not intended to apply to such rates of acclivity as those I refer to; or to such as would permit the engine to start up them, with her load, from a state of rest. For he says, "*Inconvenience would, in my opinion, result from not having the power to halt at any given point on the line of railway. This may be done, without inconvenience, on a line of road not possessing inclinations beyond the power of the engine.*" Such inclinations, my suggestions, of course, do not embrace.

This is, then, the only objection (if indeed it be one) that I have ever seen, that appears to militate against the adoption of a constant succession of short undulations. Should there be others, that have escaped my notice, I have little doubt but that they would be countervailed many fold, by the saving of expense accruing from their adoption, on almost every road in the Union. Indeed, many of our roads might, in my opinion, have been materially improved, by applying the saving that would have been thus effected, to the reduction of their maximum grades. The profile of the road would, it is true, in this last case, present a greater number of undulations; but both the time, and expense, of overcoming them, would be less than in their present condition. The increased facility of drainage, in a railroad of this undulating character, should be taken into consideration, in deciding on its adoption, or rejection. The draining of long level reaches, is, in some cases, a matter of considerable difficulty. I doubt not, most of my professional readers can recal instances in which this inconvenience could have been obviated, and a far better road-bed made at much less expense, by the use of moderate undulations, in which the acclivities need not have been one quarter so steep as the maximum grade. None but a very inexperienced engineer would abuse this system, by so arranging his undulations as to create a continual variation in the speed of the engines, so considerable as to become a source of annoyance to either the passengers, or the engine-man.

But there is, unfortunately, a very powerful antagonistic principle, subject to no laws of either science, common sense, or economy, that is too frequently brought to bear upon the grades, curves, &c., of our railroads; and that is, a puerile pride: a determination to have a *handsome* road, at all events. We know that a succession of ascents, and descents, mars the beauty of a straight line most deplorably; and as the expense of the cosmetic is paid by the stockholders, and they are not aware of its precise amount, it does not matter so much to the engineer, if the road, in consequence of these superfluous embellish-

ments, should happen never to realize any dividend. In this case, nobody ever thinks of attaching censure to him: the road is very straight, and very level; and, in their opinion, it follows that the engineer has done all that was in his power, to make the project succeed. The amount of trade he, of course, cannot control; and the very fact of his having ruined one road, thus becomes his strongest plea for procuring the management of another. Had he made a road that would pay well, his professional character would probably have suffered an injury, from which it never would have recovered. Until the *public*, therefore, as well as engineers, begin to view this matter in its proper light, we cannot reasonably hope to see the proper remedy applied. A long straight line is considered quite a stepping-stone, by our aspirants after professional fame. It shows for itself; and speaks for itself; silently, but convincingly. A straight line, five or ten miles in length, creates more *talk*, and begets more *honor*, than a judicious curved route could possibly do; although the latter would have answered just as well, and have cost many thousands less. The public must learn, that in a railroad, as in women, beauty is not a safe criterion of merit.

Another frequent source of unnecessary expense in the location of railroads, is the attendance of a "Committee of Survey," appointed from among the Directors, *to assist the engineer in making his location!* The primary object of this committee, we are in charity bound to suppose, is to prevent, by their intuitive skill, too much use of the level and compass; at least, this is certainly all they ever *do* effect. These gentlemen are generally as innocent of all knowledge of the principles of a location, as "the child unborn;" and, by their twaddle, they soon torment the very life out of the engineer. Their questions, and remarks, must be listened to; and to do this is utterly incompatible with any attention to the location. This demands, at every step, the undivided observations of even the most skilful engineer; and admits of no diversion from the main object. Therefore, after a few miles are located, the engineer, completely exhausted by his double duty, invokes all sorts of maledictions upon the committee, and determines upon the long-straight-line system, as the only relief from his misery. He starts his corps off at a tangent, through thick and thin, for some object several miles distant; and *then he is at leisure to talk.* He is commended for his long straight lines; the committee for their vigilance; and the stockholders pay the costs.

Let Directors, if they *must* appoint "Committees of Survey," give them instructions to *remain at home, and let the engineer alone;* and further, if he reports that he has finished his examinations, and surveys, in an unprecedentedly short time, discharge him, and procure

another to make a thorough and correct survey. They will generally save at least one-third of the costs of their grading by this process. *It must be a long purse, that pays for a short survey.* Although I have treated this last subject in a somewhat sportive manner, it is nevertheless one worthy of the most serious consideration. Let Directors employ an engineer, in whom they can place *unlimited* confidence for professional skill and integrity; then give him his general instructions, if they have any to give; and afterwards leave him entirely to himself in his operations. And especially let them, in their mercy, refrain from urging upon him their sons, nephews, and other "very talented young gentlemen," as assistants. Let him choose his own assistants; and let the Board abstain, most religiously, from any interference with them. They are the engineer's tools, by which he carries his plans into execution. No one else should meddle with them; to do so, will inevitably blunt their edge, and give to both the workman, and his employers, trouble and expense. Harmony among the officers, is all essential to the proper prosecution of any project; and the remark applies with peculiar force to works of internal improvement. The engineer, if he be the kind of man above supposed, will feel himself identified with the work under his charge. His interest, his pride, his professional character, are all concerned in its success. No stockholder, no director, can possibly feel that intensity of interest in it, that he does. Every effort he can make, will be brought to bear upon its successful accomplishment; but let once the Directors begin to meddle with his operations: let them pass along the line, and give directions to his assistants, or contractors: let them evince any want of confidence in his integrity, and the charm is dissolved. His interest is changed to disgust. His professional pride no longer sustains him, and inattention must *inevitably* follow; and just so certainly as that happens, the work must suffer.

If Directors could consent to leave the principal management of the matter to the engineer, there can be no doubt, that in almost every instance, he could either prevent claims for land damages entirely, or else reduce them to a very unimportant item. But to effect this, it is *essential* that he should act either alone, or through a discreet agent, who must be entirely in his confidence, and *under his control.* A sum sufficient to defray the engineering expenses of the entire work, could thus be saved, in nearly every case; but it can be done only through the engineer; and not even through him, unless he be permitted to keep his own secrets, until the whole matter is arranged.

It is not my intention to treat on the management, or conducting, of a railroad, after its completion. I will merely observe, that it is a great error to entrust it, as is almost universally done, to men of very

limited information. The general agent of transportation, under whose direction the operations of the road are conducted, should be an engineer, of considerable attainments; although it is not necessary that he should be one of the first grade. The professional ignorance of most of the conducting agents of our roads, is a lamentable source of waste. Many of our unproductive works could be made profitable, by a change in that department alone.

In conclusion, let me again earnestly request that no mis-construction be put upon the foregoing pages. There are many railroads in the United States, to which my remarks are not at all applicable; but there are also many to which they are. Where there is a very heavy trade to be accommodated, I am in favour of easy grades, curves of large radii, heavy rails, and powerful engines. But in all cases, these traits should be combined only so far as *the interests of the companies will justify.* I maintain that our engineers should construct their roads, with a view to *paying* well, instead of *looking* well; and that in looking to England for precedents, they should rather apply the *principles* there developed, to our own case, than attempt to indulge in an imitation of their splendid *practice*, when so doing must necessarily bring ruin upon those who embark their all in the enterprise. Nothing can be more evident, than that we have, in numerous instances, transcended the limits between *abstract* and *practical* perfection in our railroads. The former, as before remarked, is that in which the greatest load can be propelled by the least *power*; the latter, in which it can be done at the least *expense.* The expression, "a good railroad," is a *comparative* one; we have erred all along, in supposing it to be *positive.* It is to correct this evil, at least partially, that I have been induced, on the perusal of Mr. Ellet's pamphlet, to add my exertions to his, by the publication of these pages. Being written on the spur of the moment, and in the order they presented themselves, on reading his pamphlet, my remarks are, of course, crude and incomplete. The subject admits of much enlargement, and I hope to see it followed up in future numbers of the Journal, by more vigorous pens than mine. In the meantime, I cannot do better than to recommend to those who wish to see it more ably handled than they have found it in this paper, to study carefully Mr. Ellet's judicious remarks, in the pamphlet alluded to.

Tennessee, February, 1842.

Projected Water Works at Albany, New York.

We have been favored by W. McClelland Cushman, Esq., Civil Engineer, with a copy of a recent report made by him to the authori-

ties of Albany, on the means of watering that place from the Mohawk or Hudson River.

It appears to be settled, by long experience, (with few exceptions,) that very populous towns, cannot easily be supplied with salubrious water from springs, or wells upon their sites; because the contaminating causes incident to a dense population, sooner or later, impregnate the existing waters of the place with impurities, both offensive and deleterious.

Consequently a necessity arises, at some period of the growth of almost every town, which demands the procuration of water, for beverage and culinary uses, from distant and uncontaminated fountains.

This necessity has created an independent branch of engineering, scarcely yet reduced to the character of a precise art, the importance and utility of a clear knowledge of which—especially in a country fast increasing in population—must be manifest to all.

It has often been to us a source of regret that no authoritative work, or text book, exists, which contains at once both the principles and the details, indispensably requisite for the correct guidance of works of this character; such a production is at present a desideratum in civil engineering, and one which we do not despair of seeing supplied, by some of the able men now engaged in the important business of watering our cities.

To return to the immediate subject in hand, we conceive that Mr. Cushman by adhering too closely to the theory of this question, (of which he is undoubtedly master,) has fallen into some practical errors, which the importance of the subject as a matter of engineering, induces us to point out.

In this task we have been materially aided by consultation with practical men, entirely conversant with the experience developed in the use of those celebrated works by which this city and its suburbs are so successfully watered, *through cast iron conduits extending more than* 110 *lineal miles, and daily delivering to the people nearly four and a half millions of gallons of water.*

The following points in Mr. Cushman's report appearing to us to be discordant with practical results and views, we shall offer a few remarks upon each.

I. After establishing the height of the fountain, necessary to cause the water in the conduit to flow to the roofs of the highest houses in Albany, he proposes "for the extinguishment of fires, *an additional head of ten feet*, as great enough to force upon the roofs (from the streets we suppose,) a jet d' eau, by means of a short hose applied to the hydrant, and *without* the intervention of ladders, &c."

Upon this we may remark, that although the reservoirs at Fairmount possess an average command over the pavements of the greater part of Philadelphia, quite equal to that proposed at Albany, (55 feet,) still it is not found possible in practice here, to throw water upon the roofs of burning buildings, by the mere force of hydrostatic pressure; but almost invariably, it is from necessity first poured into engines, by the hose, and thence projected by manual labor.

In view of these facts, we can come to no other conclusion than that *the additional head of ten feet* above the levels of the roofs, will be found wholly insufficient to project from the streets a jet d' eau upon those roofs.

To strengthen this view we will observe that there is now in action at Fairmount, a jet d' eau, established under very favorable circumstances, for producing a high projection of water—the pipes of supply are of the most ample dimensions—the adjutage comparatively of small size, and duly proportioned according to art—yet it rises in the air but little over thirty feet, though actuated by the full head of the reservoir, nearly eighty feet perpendicular above the adjutage; theoretically this jet *ought to rise* much nearer to the level of its head, but the stubborn fact is that *it will not.**

II. Mr. Cushman proposes to cause his conduits to follow the average contour of the ground, graded for the purpose in planes as long as possible.

To this there can be no objection, provided sufficient strength is given to the pipes, a suitable increment of head added for every undulation of the conduit, and a proper air valve placed upon the summit of every vertical convolution.

III. Mr. Cushman proposes the construction of *"depurating sections"* and *"roil chambers,"* in the lowest undulations of the conduit, with sluices to clear these undulations from sediment.

Now as *settling reservoirs* are also proposed in this report, it seems to us that though a simple cock placed at the lowest depressions, might occasionally be serviceable, the *sediment apparatus*, as planned and described, is both unnecessary and objectionable—*unnecessary*, because experience in this place, where undulations of the con-

* It may be useful to be more explicit in describing this jet d' eau; the pipe of supply consists first of an old sixteen inch main—devoted to this purpose only—which descends from the reservoir, on the summit of Fairmount, to a plane about eighty feet below it; here a branch pipe, of four inches calibre, is taken off horizontally about one hundred feet to the fountain, where it joins *a short vertical pipe* of one inch in diameter, which at the adjutage is contracted gradually to five-eighths of an inch, by means of cones, according to the principles of Venturi; and, though an orifice in a thin plate set in the four inch pipe, would have been more effective, still this is a case favorable to the production of a high jet—yet such a jet as might have been expected *does not result.*

duits are frequent, indicates that if the pipes are laid in sections of *uniform aperture*, duly proportioned to the service they perform, and possessing a suitably commanding head, it is only requisite to open the fire plugs occasionally to produce an effectual scour through the pipes, and bring forth any sediment which may have lodged within them;—*objectionable*, because the *roil chambers* being *enlargements* of the conduit, *preceding a contraction*, will obstruct the flow of the water, and have a direct tendency to produce the very evil they are designed to cure, whilst at the same time they would occasion an additional expense, which might be much more advantageously applied to augmenting the altitude of the working head of water.

IV. Mr. Cushman calculates that a thickness of one-twentieth of an inch of cast iron would be "*amply sufficient*" for an eighteen inch conduit pipe, working under fifty-five feet head! But for perfect safety he finally establishes the thickness at fivefold, or *one-quarter of an inch*, and thence estimates the weight of metal per mile of conduit, at 103⅓ tons.

Now the cast iron conduits of this city, of eighteen inches calibre, working many of them under a head not exceeding that mentioned above, have had their proportions established by over twenty years' practice, and are now made *two-thirds of an inch* thick in the body, and weigh 410 lbs. to the yard lineal, or 322 tons per mile of pipe, *being more than treble that prescribed by Mr. Cushman!*

We may, possibly, be told that two-thirds of an inch is a much greater thickness than would be dictated by formulæ based upon the known value of the cohesive force of cast iron—and this we readily admit; but at the same time, *here is the practical fact*, that the conduits in the general plane of Philadelphia—working under nearly the same head as that proposed at Albany—require to be made two-thirds of an inch thick, and tested, too, by Bramah's press, under an hydrostatic pressure equivalent to 300 feet head, before being laid down; yet notwithstanding all this, they do sometimes fail, *though very rarely*, and though it may be said with truth that these failures usually occur at imperfections, still it shows the large margin necessary in practice, to guard against those very imperfections, which are unavoidable in castings, and which the hydraulic press does not always point out.

If, then, the conduit pipes for the water service of Albany, be proportioned by the practical scale established by more than twenty years' actual experience here—the propriety of which but few will question—the cost of this item alone will thrice excel that expressed in Mr. Cushman's estimates, (p. 21 of the report,) or be more than $300,000, instead of less than $100,000!

V. Mr. Cushman proposes that the pipes should be cast in lengths of fifteen feet.

And on this we shall only remark that those of nine feet long have hitherto been found sufficiently difficult *to cast well*, and the opinion of practical men in this quarter is decided, that *good pipes* cannot be cast in lengths of fifteen feet, without increasing the weight per lineal yard, to guard against unavoidable imperfections.

VI. Mr. Cushman proposes *to use zinc instead of lead* to seal the joints of the conduit pipes, under the impression that by galvanic action it will prevent the iron from corroding.

Of this plan it may be observed, that wherever one metal in a galvanic circuit is protected by *another*, it must be at the expense of *that other;* if, then, the zinc joint protected the iron pipe, it would be *itself* corroded, and from this cause the joints would soon become imperfect, and need repair.

Moreover (to take no account of its extra cost,) zinc is too friable to admit of being set up with the cold chisel, after being cast into the joint—which is an indispensable precaution—and it may well be doubted, whether its very slight ductility would successfully admit, the expansion and contraction which takes place in metallic conduits, and to which the common joint of lead so admirably adapts itself, as to leave absolutely nothing to be desired, in point of tightness and durability; indeed, some which have recently been examined *after thirty-three years' use, were found to be in perfect order.*

VII. Mr. Cushman proposes so to gear his forcing pump that the water in the rising main, when the pump is working, shall have a velocity of *only sixty-five feet per minute*, or "thirty single strokes" of a twenty-six inch barrel.

Now experiments at Fairmount have conclusively shown, that when the working velocity of the water in the main, ascending from the forcing pump to the reservoir, *is less than* 120 *feet per minute*, the momentum is not kept up, whilst the piston clears its dead points; and consequently a reaction then takes place upon the principle of Mongolfier's ram, which would quickly destroy the most solid apparatus; it is on this account, as well as with the view of avoiding gearing, that the water wheels at Fairmount are run so much faster than theory dictates—or than otherwise would be desirable—and not from any want of knowledge of the best abstract velocity at the skirt, as some uninstructed critics have imagined.

The length of the force pump stroke, as proposed by Mr. Cushman, is twenty-six inches, which, we are inclined to believe, *is too short for advantageous action.*

There are some other points in the report under review which seem

open to objection, but as they are comparatively of minor importance, we will conclude our remarks without entering upon their discussion; indeed nothing but the importance of this practical question could have induced us to review Mr. Cushman's report at all, as we entertain the highest respect for his talents, and feel convinced that with a closer attention to practical results, he would unavoidably have been led to conclusions identical with those above enunciated.

Facts and Observations on Four and Six Wheel Engines. By John Herapath, Esq.

[continued from page 320.]

Birmingham and Gloucester Railway.

Having heard a good deal of the American, or Bogie, engines, I was desirous of riding on them, and Captain C. R. Moorsom, the Chairman, and Mr. Sturge, one of the Directors of the line, having politely granted me permission, I went on the 16th ult. from Birmingham to Cheltenham, 46 miles, on one of Norris' engines, and returned on a copy of the principle built in England.

The readers of the *Railway Magazine* are aware that one of the distinguishing features of these engines is the cylinders being outside, near the head of the engine, with a very long connecting link, or rod, turning by a pin the hind wheels, four feet diameter. Another is the bogie front, that is, four two feet six inch wheels, the two axles of which are very close together, attached to a frame, which has considerable motion round a vertical pin. By this means the engines traverse a curve of only ten chains radius near the Birmingham station with great facility, and without, as far as I could perceive, any undue strain.

I went from Birmingham to Cheltenham on one engine, an American, of Norris' make, and came back on an English model of it.

The first, No. 7, the *Atlantic*, I was informed by Mr. Bishop, the intelligent superintendent of locomotives, who went with me as far as Broomsgrove, weighs in its working trim near ten tons, with about six on the driving wheels. Its cylinders were ten and a half inches, with an eighteen inch stroke. At first I was very much pleased with this engine, and fancied it was the steadiest I had yet traveled on. Its lowness and easy motion at moderate speeds won very much upon me, and impressed me with great confidence. When, however, we came to a speed of above twenty miles an hour, or up to twenty-five or thirty miles, the motion on the platform was a most disagreeable wriggling side motion, which kept time, as far as I could judge, with the beats of the pistons. It was the same on both engines at the same speed. I tried in vain to discover the cause of it. No such motion, or anything approaching to it, had I observed in any engines on which I had been. Mr. Bishop and myself thought, while traveling on the engine, it might be owing partly to the road, and partly to the play of the axles in the bearings; but as it corresponded in both engines, I

was subsequently inclined to think it owed nothing to the road, and was due entirely to the vibrations occasioned by the sudden checks of the matter in the piston, and its material, and the working of the engine against itself, that is, its working too quick for the steam behind the piston to have time to escape. It is probable, therefore, that was the expansive action of the engines—for I am informed they work in part expansively—adapted to the highest velocity required, and the steam behind the piston allowed to escape earlier, none of this unpleasant motion would exist. But these engines are put to motions they were obviously never intended for. Thirty and more miles an hour, which they often travel, they plainly tell us by their laborious motions they are unequal to.

As a part proof of this, I am informed that four engines which the Company have had made, with outside cylinders and five feet driving wheels, by Forrester, to take the mail trains, have no such motions as are found in the American engine and its English imitation.

From what I have seen, I am no great admirer of American engines for general purposes, though the men relate marvellous things of them upon that line.

Besides the wriggling motion mentioned, I could very plainly distinguish the same sinuous motion I had observed on the South Western and London and Birmingham lines.

Captain W. S. Moorsom, the engineer of the line, seems to have a very good opinion of the principles of these engines. I am sorry to differ from a gentleman for whose talents I have a very great respect, but if I am to form my judgment from the two whose performances I have witnessed, they will not have an advocate in me. I could compare their uneasy wriggling motions at high velocities, to nothing but that shuffling amble which is observable in some small ponies, and I cannot help thinking but that they must have considerable wear and tear, and be expensive to keep up: and this, I since find, is fully borne out by the facts. Some of the men, however, are enthusiastic in their favor, and ridicule the idea of "Bury's engines" being able to compete with them on their line. They say the trial has been made, and the superiority of the American engines placed beyond a doubt. The rationale of this I am unable to see, but if it be so, it settles the question, and proves that little engines, like little horses, are best suited for hilly countries; but why then, as it will presently be seen, are the Company improving them, by substituting five feet, for four feet driving wheels?

The length of line worked by this Company is fifty-five miles, including the Tewkesbury branch of two miles; and when the Worcester branch is opened, four miles, and the line extended one mile further, to join the Gloucester basin, which I understand is now in progress, the total distance worked will be sixty miles; the cost of construction of which will be between £24,000 and £25,000 a mile.

The locomotive stock of this Company consists of twenty-nine engines, including three ballast engines and three "bank engines," to help up the Lickey incline, which last three never work trains. All the traffic engines are six wheel, with bogie frames, to the centre of

which the smoke-box is attached by a centre pin, the engine framing on both sides of the smoke-box resting on stands acting on the bogie frame springs. The cylinders are all outside, and the framings, except of four, all inside. There being no crank axles, the driving-wheels are set back close to the fire-box. The weight of the engines varies from ten to thirteen tons, in their working trim, of which from six to eight lie on the driving-wheels. Most of their engines have driving-wheels only four feet diameter, and the four other wheels being two and a half feet, but they have an engine with five feet driving-wheels, and four others with five and a half feet, the leading wheels of which are from two and three-fourths to three and a half feet diameter. Improvements are now making in these engines, by putting on five feet driving wheels, "and giving as much head as possible to the reduction," or exhaustion, of the steam.

Eighteen of the traffic engines, including the three bank engines, are now in an efficient state. The detentions have been rather numerous, in consequence of the pumps, and other parts of the engines, with the small driving-wheels, having occasionally failed; but it does not appear that they ever had a driving axle fail, except a crank axle in an old ballast engine, eleven years old, which happened at some temporary points; nor have they ever had any engine run off the line. The average cost of the engines is £1,430.

Their gross loads are about fifty-one tons; their consumption of coke, thirty pounds to the mile in Forrester and Nasmyth's engines, and forty pounds in the others.

With regard to their own engines, they find the five and a half feet driving wheels work the best. The chief motions are the sinuous and horizontal vibrations, or tremors, which are most conspicuous in the *Bogie* engines on descending gradients, but on curves there is little or no difference. These motions are considered to be in part, but not wholly, due to the road. They have no top-heavy engines, nor any direct proof that the distance of the cylinders from the principal axis of the engine, has any effect on the sinuous motion; but Mr. Bishop is of opinion that the outside cylinders have.

The average expense of repairs of their engines, for the half-year ending the 30th of June, was £103 per engine, including several new copper fire boxes and tubes, the total distance run in the same time being 110,000 miles. The steam pressure is 60 lbs. per square inch.

Their best engines are Forrester's, three years old, and the worst the *American*, two years old. In their fastest and least expensive engines, the moment the steam is cut off from the induction pipe, the eduction is opened.

Mr. Bishop has addressed a letter to me since I have been out, in reference to the premiums for economizing the coke, in which he says: "for the last three months' consumption, I find forty-four pounds of coke per mile as the general standard, and for every pound which the fortnightly returns show it to be under, the men have £2 to divide among them. Thus, the first fortnight the average was thirty-eight pounds, and therefore the men had £12; the second fortnight the average was thirty-nine pounds, and the men had £10. Each driver's

share for the month was 14s. 8d., the firemen, cokemen, &c., receiving less, in proportion to their wages."

London and Birmingham Railway.

The locomotive stock of this great Company consists of ninety engines, that is forty-two with twelve inch cylinders and eighteen with thirteen, all uncoupled engines; and thirty coupled engines, with thirteen inch cylinders for goods. All these engines are four wheel, and have inside bearings. The weight of the 12-inch cylinder engines, in their working trim, is 9¾ tons, having 5 tons 18 cwt. on the driving wheels, and 3 tons 17 cwt. on the front wheels; the 13 inch uncoupled weigh 11½ tons, with 6 tons 11 cwt. on the driving-wheels, and 4 tons 19 cwt. on the front; and the 13-inch coupled weigh 11 tons 13 cwt., of which the same weight, 6 tons 11 cwt., lies on the driving-wheels, and 5 tons 2 cwt. on the leading wheels. The coupled engines are said to work most satisfactorily, but I presume this is meant for goods, as whenever they are worked with the passenger trains, that is at high speeds, I observed the coupling rods are taken off.

Of these 90 engines, 81 are now in an efficient state, and ready to take a train.

During the last two years there have been ten cases of fractured crank axles. In no instance, however, did the engine fail to take its load to the next station. Seven of these cases have been with goods on coupled engines, and only three with passenger or uncoupled engines. The cause is alleged to have been that singular fact mentioned in my account of the Grand Junction engines, namely, the deterioration of the quality of the iron of the axles from use, which converts hot short into cold short iron.

From these fractures no personal injury was done to any one.

It appears that there has been but one solitary instance (Nov. 4th, 1837) of any engine having run off the rails, which happened between Harrow and the Brent, and was caused by the unsound state of a part of the road then newly opened. It happened with one of the 12-inch cylinder uncoupled engines.

The average pressure of steam is about 50 lbs.; consumption of coke, 40 lbs. per mile; and the gross loads taken are given to me as 61 tons, but I suspect this is the average passenger loads, for we often see trains of goods of an almost interminable length.

It is a fact worthy of notice that their heavier trains are the up, that is, those towards our bottomless gulph—the metropolis—a circumstance which was not contemplated or foreseen before the line was opened.

The cost of their engines is from £1,300 to £1,350, exclusive of tender; the annual expense of repairs, per mile run, about 3½d., and the number of miles run, from June 15, 1840, to June 15, 1841, was 1,066,014. They have no top-heavy engines, and the motions chiefly observed are the sinuous. If an engine has any other motion, it is always found where the road is imperfect.

Their oldest engine, No. 1, I understand has been at work from July, 1837, and is still perfectly effective and steady.

Some very cogent reasons are given me for the preference by this Company of four wheel engines to six; but as they are somewhat long, I have thought it better to reserve them for my report.

More detailed accounts are, that for 6 months ending the 15th of June last, there were employed 16 foremen, clerks, and store keepers; 51 engine drivers, 8 stationary enginemen, 50 firemen, 168 cleaners, cokemen, and laborers on running engines; 93 fitters, erectors, and millwrights; 16 turners, 6 men working on machines, 11 carpenters and pattern makers, 5 coppersmiths, 9 brassfounders, 23 blacksmiths, 3 spring-makers, 36 stokers, 22 boiler-makers, 4 painters, 6 general laborers, and 12 boys; making a total of 539 men and boys. And this number, it will be observed, is employed solely in the locomotive department and in repairs, without any being employed in the manufacture of new engines. Their places of occupation are at four stations.

The 6 months wages for enginemen, firemen, cleaners, cokemen, and laborers on traffic, amount to £7,444 18s.; the coke consumed was 10,012 tons, costing £16,139 6s. 8d.; the oil, 4987 gallons, at an expense of £827 2s. 6d.; the cost of water and firewood, £859 6s. 10d.; the wages or repairs, repairs not done by the Company, and stores or repairs, were £9,448 8s. 5d.; and general charges for tools, stationary power, clerks, foremen, store keepers, and other incidental expenses, were £6,389 10s. 7d., making a grand total of £41,108 13s.

The miles run, including assistant and pilot engines, with passenger trains, were 416,995, and with goods, 126,923. The average weight of passenger trains, exclusive of engine and tender, is 40 tons, and of goods with the same exclusion, 86 tons; and coke consumed per mile for all the trains, including getting up the steam, waste in stoppages, rests, &c., 41 lbs.; the average cost of repairs per mile run, was 4.17d., and of coke, 7d.; and the total cost per mile, including everything, 17.68d.

Six hundred bridges, or between 5 and 6 to a mile, I have been informed, are upon this line, many of them of course perfectly useless, and wantonly extorted from the Company in the progress of the Bill through Parliament. By the vultures in the House, and the cormorants out, near half a million of money was plundered from this Company, for land only, over and above its reasonable value. Had the Parliament exercised a little common sense, instead of the uncommon folly which dictated the 10 per cent. clause, it might, in suppressing the robberies for land and compensation only, have saved this Company more than sufficient to enable it to carry the mail-bags for nothing.

This great line, as the readers of the *Railway Magazine* know, unites the metropolis of the British empire with Birmingham, and forms the main railway artery to the north and north-west of England. Though it passes over a difficult country, its gradients are pretty good, that is, none I believe exceeding 16 feet a mile, except 1¼ mile at the London end, worked by a stationary engine.

Much of the material on the line is good, but there are other parts

containing that untiring nuisance to railway engineers, called clay. Here is a constant source of expense; which, however, the large and ample revenue of the Company feels but slightly in comparison to what other Companies would. By constant vigilance these parts are kept in good repair; and, from what I have observed on other railways, though it has not escaped the influence of the late rains, it has felt them less than most, and far less than some.

It has often been asserted to me, that this line is incapable of managing the immense traffic which flows in upon it, and that another line will be necessary to the north. While I have been out I have endeavored to pay some attention to this, for the purpose of obtaining correct ideas thereon. I have, as far as my opportunities would allow me, watched their operations, examined their force, and considered their system, and I am of opinion that their force is so ample, and management so systematic and apparently so easy, that I am of opinion double the present traffic would not much inconvenience them, even as they now are, while I think there can be no doubt that the line might easily take three or four times the quantity it now does.

Monday, Nov. 22nd.—I again traveled upon two of the Company's engines, namely, No. 44, a two year old mail engine, and No. 9, both built by Bury. The first engine I found not near so steady as the second, which was also much more lively, and tripped off with her load in gallant style. I was informed the first consumed 12 cwt. of coke in 52½ miles, and the second 14 or 15 cwt. in 60.

On Thursday, December 9, I came once more upon the line, in my return from the north, and I rode on No. 5 and No. 79. The latter was a coupled engine, with the coupling rods off. Having now been accustomed for two or three weeks to six wheel engines, and somehow had the sympathy of my prejudices excited in their favour, from the constant vibration in my ears of other parties' opinions in their favor, I entered the line with probably more unfavorable than impartial notions of four wheel engines. I imagined my former experience of them to be erroneous, and that I was now about to see the opinion of those I had mixed with, of their roughness, pitching, rolling, and dancing about, confirmed. I was, however, most agreeably surprised to find, not only my previous sentiments of them strengthened, but that they certainly were, to my mind, superior to the majority of six wheel engines in which I had ridden. As it was probably the last time I should be on this line in this survey, I tried these two in every way I could, and I found them comparatively free from the distinguishing motions of other engines, and most decidedly vastly more free from them than nine out of ten six wheel engines I had tried. No. 5 was a very steady engine, but No. 79 appeared to me to be steadier, and sweeter in her motions.

In examining these engines, I found them very firmly put together. The wheels of No. 79, contrary to other engines I had been on, appeared to have no sensible play whatever in the axles; they were so perfectly vertical to the axle-trees, that they ran with the greatest truth. I cannot say that either of these engines was wholly free from

longitudinal, or lateral, motion; but at velocities of about 30 miles an hour, it existed in them in a very small degree.

In now taking my leave of the London and Birmingham Company, I only discharge my duty to my conscience in acknowledging that their whole conduct to me, throughout this affair, has been one unvaried course of kindness and attention. Everything I have asked has been promptly granted me; every assistance I have needed has been given in a way to double the pleasure of receiving it. So far from holding back, they have seemed to take a pleasure in anticipating my wants or my wishes; and that generous conduct which began with Mr. Glyn and Mr Creed, has been handsomely followed out by his assistant, Mr. Long, and Mr. Robinson, Mr. Jones, and every other officer and servant of the Company, with whom I have come in contact, or had intercourse.

Railway Mag. Dec. 1842.

[TO BE CONTINUED.]

Advice to Stockholders in Railroad Companies, from Herapath's Railway Magazine, but suited as well to the Western, as to the Eastern Hemisphere.

The period has now arrived, when in most cases the lines are completed, and questions of construction have to give way to those of administration. The lines are made, the great point now is to make the most of them by extending the traffic, and by regulating the expenditure. Let every Shareholder keep a watchful eye as to what is going on, for his conduct at the present meeting will much determine his dividend at the next. Let him see that the traffic is carried to its full extent by moderate and profitable fares, and what means exist of bringing other lines into communication, or assisting in the formation of new ones. He must have satisfactory explanations that the expenditure is not upon sinecure or extravagant offices, at the same time that he must take care that the officers and servants of the company are properly paid. A few well-paid officers are worth a legion of under-paid and discontented pensioners, and false economy with this class may, as in recent cases, be not without its effect upon the income. We cannot refer to the recent defalcations, and to the discontent prevailing among railway employees, without alluding to the fact of the dividend of the Manchester and Birmingham Railway Company having this half year suffered a diminution in consequence of misconduct on the part of one of the establishment. A lesson this, which will not, we trust, be lost upon those who are inclined to penny wisdom and pound foolishness. A cheap, that is, an unqualified servant, will always waste more than is saved on his salary, doing less work, and requiring more superintendence.

To secure good management, it is not enough to ask for it or to talk about it, but to choose the men best qualified. Where you have no auditors, ask for them, and insist upon having them, and chosen by yourselves—where you have to fill up vacancies in the direction, take care to put in proper men. Many a line at the present moment

requires a sharp eye; there are other things than the petty fees to attract the corrupt or the greedy; in the expenditure of thousands and hundreds of thousands, there is much more to be got by a practised hand, than from all the fees that a most diligent attendant can finger. The fees, we are convinced, attract but very few, and those, perhaps, the best men, the real working men; vanity and the love of pre-eminence and power may incite some; but the main incitement towards the direction, in low minds, is the love of a job. These are men to be closely looked to, men who will use every exertion to intrigue themselves into office, and then remunerate themselves at the expense of their constituents. One of these men is in league with a coal-merchant, another with a coachmaker, a third supplies timber sleepers, and a fourth, rails. Even to the clothing of the policemen, the oil and grease for the engines, and the stationary for the office, nothing is beneath the notice of these worthies; every one has a share of the spoil, and so generally are some boards affected with these practices, that the contracts of the line are as sytematically quartered out as the patronage of a cabinet, and each receives a share according to his merits. Mr. Alderman Jobbins has a son who is a tailor, and he takes the clothing; Mr. Deputy Grub lays his hands on the supply of coals and coke; the Chairman walks off with an order for rails; and his deputy undertakes to get the carriages repaired. These are very useful things to keep up influence in a man's parish, or ward, while the several parties who reap the fruits of the system are bound to use their power in keeping the Directors in place. Neither are such Directors always contented with their fees, or their patronage, but frequently they must have vestry dinners at the Company's expense, and turn the board room into a free and easy, where pots of porter and mutton chops are brought to aid the deliberative powers of the midday councillors, and restore their energies, exhausted not in the Company's service. All these things are to be looked at, and the parties engaged in them, when found out, to be removed from office; but Shareholders will do but half their work if they are not at the same time cautious by whom they are replaced. There can be little difficulty now in finding a sufficient number of tried public men, who are willing to accept office, and there is quite enough legitimate patronage and power to render any plea for jobbing quite inexcusable.

Physical Science.

History of the Reflecting Telescope. By the Rev. T. R. Robinson, D. D., M. R. I. A.

After explaining the relative importance of magnifying and illuminating power, Dr. Robinson proceeded to give a brief sketch of the history of the reflecting telescope, which seemed to have been forgotten for many years after its invention, till it was revived by Hadley. The labours of Short soon gave it celebrity; yet even this artist limit-

ed himself in almost every instance to sizes which were not more powerful than the achromatics of his day, and his large instruments appear to have been failures.* It was not till a full century after the publication of Newton's paper, that Sir William Herschel gave this telescope the gigantic development which has crowned him with imperishable fame; and by the construction of telescopes of nineteen and forty-eight inches aperture, placed regions almost beyond the scope of measurement, within the reach of human intellect. But as Short, in a spirit unworthy of his talents, took care that his knowledge should die with himself, and Herschel published nothing of the means to which his success was owing, the construction of a large reflector is still as much as ever a perilous adventure, in which each individual must grope his way. Accordingly, the London opticians themselves do not like to attempt a mirror even of nine inches diameter, and demand a price for it which shows the uncertainty and difficulty of its execution. In Ireland we are more fortunate, for a member of our Academy, Mr. Grubb, finds no difficulty in making them of admirable quality up to this size, or even fifteen inches; but with all his distinguished mechanical talent, he is believed to be doubtful of the possibility of more than doubling this last magnitude in perfect speculum metal.

Under these circumstances, too much praise cannot be given to Lord Oxmantown, who, in the midst of other pursuits, has found leisure for such researches; and by a rare combination of optical science, chemical knowledge, and practical mechanics, has given us the power of overcoming the difficulties which arrested our predecessors, and of carrying to an extent which even Herschel himself did not venture to contemplate, the illuminating power of this telescope, along with a sharpness of definition scarcely inferior to that of the achromatic.

The chief difficulties which are to be overcome in the construction of reflectors, arise from the excessive brittleness of the composition of which specula are made, and from the necessity of giving them figures which shall be free from aberration. The great mirror in the Newtonian form is (if the eyepiece and plane mirror be correct) the conical paraboloid.

It is necessary that speculum metal should possess, in the highest attainable degree, the qualities of whiteness, brilliancy, and resistance to tarnish. Lord Oxmantown has found that these conditions are best satisfied in the *definite* combinations of four equivalents of copper to one of tin; or by weight, 32 and 14.7 nearly. Metals differing from this by a slight excess of either component, are, when first polished, scarcely less brilliant, but are dimmed so rapidly that the lapse of a few days produces a sensible difference. On the other hand, some large specula of the atomic compound have been lying uncovered for years, without material injury to their polish.

But this compound is brittle almost beyond belief; a slight blow,

* A Newtonian of six feet focus, and 9.4 inches aperture, is said by Maskelyne to have shown the first satellite of Jupiter 13″ longer than a *triple* achromatic of 3.6 inches aperture. The telescope of twelve feet focus, and eighteen inches aperture, now at Oxford, showed multiple rings of Saturn.

or even the application of partial warmth, will shiver a large mass of it; though harder than steel, its surface is broken up with the utmost facility, and it has a most energetic tendency to crystalize. The common process of the founder fails with it, except for masses of very limited magnitude, as the cast cracks in the mould; and the subsequent difficulties of the annealing are such, that it has been a very general practice to use an alloy lower (containing more copper) than the atomic standard. Even Sir William Herschel was obliged to yield to this necessity. It appears from a letter of Smeaton, (Rees's Encyclopædia, Art. Telescope,) that for his 20-foot mirror of 19 inches aperture, the composition was 32 copper to 12.4 tin, and that for the 40-foot it was even lower; yet two out of three attempts to cast this huge speculum failed.

Lord Oxmantown at first endeavoured to evade the difficulty, by constructing a speculum in pieces, soldering plates of fine metal to a back of a peculiar brass, ascertained to have the same expansion; and has completed one of thirty-six inches aperture, and twenty-seven feet focal length, which performs very well on stars below the fifth magnitude, but above that exhibits a cross formed by the diffraction at the joints; and in unsteady states of the air exhibits the sixteen divisions of the great mirror on the star's disk. By diminishing the number and size of the joints it is found that these inconveniences can be diminished, so as to be scarcely perceptible; and in all probability this is the process by which the remotest limits of telescopic vision will ultimately be attained. It is, however, not necessary for instruments of even greater dimensions than this, since Lord Oxmantown has succeeded, by a contrivance as simple as ingenious, in casting, at the first attempt, a *solid* mirror of the same size; and there is no reason to suppose that it will be less effective on a much larger scale.

But however difficult it may be to obtain the rough speculum of large dimensions, it is still more so to give it a proper figure, combined with that brilliant polish which is technically called black, because it reflects no light out of the plane of incidence. In such mirrors as can be wrought by hand, they are worked by short cross strokes on the polisher, and at the same time have a slow rotation relative to it. This might be expected to produce merely a spherical figure; but by varying the length of the stroke, by circular movement, elliptic figure of the polisher, or removing portions of its pitch covering, a parobolic figure is obtained. For sizes above nine inches diameter, the work must be performed by machinery: but in all which Dr. Robinson has seen, (the most remarkable of which are those of Sir William Herschel* and Mr. Grubb,) the cross stroke is given by a lever moved by hand: and it is supposed that perfect results cannot be obtained but by the *feeling* of the polisher's action. Sir John Herschel is believed to have made important additions to his father's apparatus; and it is to be hoped he will soon redeem his promise (Mem. R. Ast. Soc., vol. vi,) of publishing his improvements.

* Dr. Robinson had the good fortune to see this at Slough, in 1830, while at work on a twenty-foot mirror.

Lord Oxmantown has in many respects deviated from the usual process. His polisher, of the mirror's diameter, intersected by transverse and circular grooves into portions not exceeding half an inch of surface, is coated, first, with a thin layer of the common optical pitch, and then with a much harder compound. It is worked *on* the mirror, and counterpoised, so that but little of its weight bears; but the want of pressure is compensated by a long and rapid stroke. The mirror revolves slowly in a cistern of water, maintained at a uniform temperature, to prevent the extrication of heat by friction. The polisher moves slowly in the same direction, while it is also impelled with two rectangular movements. The machine is driven by steam, and requires no superintendence, except to supply occasionally a little water to the polisher, and to watch when the polish is complete. By an induction from experiments on mirrors from six to thirty-six inches aperture, it was found that if the magnitudes of the transverse movements be $\frac{1}{3}$rd and $\frac{9}{100}$th of the aperture, and their times be to its period of rotation as 1 and 1.8 to 37, the figure will be parabolic: but to combine with this the highest degree of lustre, it is found necessary to apply, towards the close, a solution of soap in liquid ammonia, which seems to exert a specific action.

The certainty of the process is such, that the solid mirror of thirty-six inches aperture, after being scratched all over its surface with coarse putty, was, in Dr. Robinson's presence, perfectly polished in about six hours, and was placed in its tube for examination without any previous trial as to quality.

Lord Oxmantown has preferred the Newtonian to the Herschelian form, and, in Dr. Robinson's opinion, with good reason. In the latter, the inclination of the great mirror to the incident rays must deform the image,* and it is now known, that even with faint objects sharp definition is of high importance. It should, in fact, be a segment of a paraboloid, exterior to the axis; and though a theorem of Sir William Hamilton (Trans. Roy. Irish Acad., vol. xv., p. 97) might seem to indicate mechanical means of approximating to the figure, yet Dr. Robinson fears there would be greater difficulty in applying them than in enlarging the aperture of the Newtonian, so as to make up for the loss of light. Another serious objection is, that in the Herschelian the observer's position at the mouth of the tube must cause currents of heated air, which will materially interfere with sharpness of definition.

As to the loss of light by the second reflection, Dr. Robinson thinks it has been much overrated, and expresses a wish that a careful set of experiments were made on reflection by plane specula at various incidences, on prisms of total reflection, and the achromatic prisms, proposed as a substitute by Sir David Brewster.

As to the rest of the instrument, it may suffice to say, that it bears a general resemblance to that of Ramage, but that the tube, gallery,

* Any one who has a Newtonian telescope can verify this, by inclining a little the great mirror, so however as not to pass the edge of the plane mirror by the pencil. In Lord Oxmantown's instrument, an inclination of 11′ sensibly injures it; were it Herschelian, the inclination must be 3° 11′.

and vertical axis of the stand are counterpoised, so that one man can easily work it, notwithstanding its enormous bulk. The specula, when not in use, are preserved from moisture or acid vapours, by connecting their boxes with chambers containing quicklime, which is occasionally renewed. This arrangement (which also occurred to Dr. Robinson, and has been for several years applied by him to the Armagh reflector,) appears to be very effective in preserving the polish.

In trying the performance of the telescope, Dr. Robinson had the advantage of the assistance of one of the most celebrated of British astronomers, Sir James South; but they were unfortunate in respect to weather, as the air was unsteady in almost every instance; the moonlight was also powerful on most of the nights when they were using it. After midnight, too, (when large reflectors act best,) the sky, in general, became overcast. The time was from October 29th to November 8th.

Both specula, the divided and the solid, seem exactly parabolic, there being no sensible difference in the focal adjustment of the eyepiece with the whole aperture of thirty-six inches, or one of twelve; in the former case there is more flutter, but apparently no difference in definition, and the eyepiece comes to its place of adjustment very sharply.

The solid speculum showed α Lyræ, round and well defined, with powers up to 1000 inclusive, and at moments even with 1600; but the air was not fit for so high a power on any telescope. Rigel, two hours from the meridian, with 600, was round, the field quite dark, the companion separated by more than a diameter of the star from its light, and so brilliant that it would certainly be visible long before sunset. ζ Orionis, well defined, with all the powers from 200 to 1000, with the latter a wide black separation between the stars; 32 Orionis and 31 Canis minoris were also well separated.

It is scarcely possible to preserve the necessary sobriety of language, in speaking of the moon's appearance with this instrument, which discovers a multitude of new objects at every point of its surface. Among these may be named a mountainous tract near Ptolemy, every ridge of which is dotted with extremely minute craters, and two black parallel stripes in the bottom of Aristarchus.

The Georgian [Herschel] was the only planet visible; its disk did not show any trace of a ring. As to its satellites it is difficult to pronounce whether the luminous points seen near it are satellites or stars without micrometer measures. On October 29th, three such points were seen within a few seconds of the planet, which were not visible on November 5th; but then two others were to be traced, one of which could not have been overlooked in the first instance, had it been in the same position. If these were satellites, as is not improbable, there would be no *great* difficulty in taking good measurement both of their distance and position.

There could be little doubt of the high illuminating power of such a telescope, yet an example or two may be desirable. Between ε^1 and ε^2 Lyræ, there are two faint stars, which Sir J. Herschel (Phil. Trans., 1824) calls "debilissima," and which seem to have been, at

that time, the only set visible in the twenty-foot reflector. These, at the altitude of 18°, were visible *without an eye-glass*, and also when the aperture was contracted to twelve inches. With an aperture of eighteen inches, power 600, they and two other stars (seen in Mr. Cooper's achromatic of 13.2 aperture, and the Armagh reflector of 15) are easily seen. With the whole aperture, a fifth is visible, which Dr. Robinson had not before noticed. November 5th, strong moonlight.

In the nebula of Orion, the fifth star of the trapezium is easily seen with either speculum, even when the aperture is contracted to eighteen inches. The divided speculum will not show the sixth with the whole aperture, on account of that sort of disintegration of large stars already noticed, but does, in favourable moments, when contracted to eighteen inches. With the solid mirror and whole aperture, it stands out conspicuously under all the powers up to 1000, and even with eighteen inches is not likely to be overlooked.

Comparatively little attention was paid to nebulæ and clusters, from the moonlight, and the superior importance of ascertaining the telescope's defining power. Of the few examined were 13 Messier, in which the central mass of stars was more distinctly separated, and the stars themselves larger than had been anticipated; the great nebula of Orion and that of Andromeda showed no appearance of resolution, but the small nebula near the latter is clearly resolvable. This is also the case with the ring-nebula of Lyra; indeed, Dr. Robinson thought it was resolved at its minor axis: the fainter nebulous matter which fills it is irregularly distributed, having several stripes or wisps in it; and there are four stars near it, besides the one figured by Sir John Herschel in his catalogue of nebulæ. It is also worthy of notice, that this nebula, instead of that regular outline which he has there given it, is fringed with appendages, branching out into the surrounding space, like those of 13 Messier, and in particular, having prolongations brighter than the others in the direction of the major axis, longer than the ring's breadth. A still greater difference is found in 1 Messier, described by Sir John Herschel as "a barely resolvable cluster," and drawn, fig. 81, with a fair elliptic boundary. This telescope, however, shows the stars as in his fig. 89, and some more plainly, while the general outline, besides being irregular and fringed with appendages, has a deep bifurcation to the south.

From these and some other discrepancies, Dr. Robinson thinks it of great importance that the globular nebulæ and clusters should be all carefully reviewed, as it is chiefly from their supposed regularity that the hypothesis of the condensation of nebulous matter into suns and planets has arisen; an hypothesis which he thinks has, in some instances, been carried to an unwarrantable extent.

On the whole, he is of opinion that this is the most powerful telescope that has ever been constructed. So little has been published respecting the performance of Sir W. Herschel's forty-foot telescope, that it is not easy to institute a comparison with *that*, the only one that can fairly be made to compete with it. But there are two facts on record which lead to the inference that it was deficient in defining

power: one, the low power used, which Dr. Robinson thinks was not above 370; the other, the circumstance that neither the fifth nor sixth stars of the trapezium of the nebula of Orion were shown by it. As to light, there is no reason to believe that the composition of the forty-foot mirror was as reflective as that of the twenty foot; and if Dr. Robinson be correct in the opinion, that the latter* did not show the fifth star easily, or the sixth at all, and that it only exhibited the "debilissima" and one star near the ring nebula, then *it* has decidedly less illuminating power than eighteen, perhaps not more than fourteen inches aperture of Lord Oxmantown's mirror, notwithstanding the loss of light in that by the reflection at the second speculum.

However, any question about this optical pre-eminence is likely soon to be decided, for Lord Oxmantown is about to construct a telescope of unequalled dimensions. He intends it to be six feet aperture, and fifty feet focus, mounted in the meridian, but with a range of about half an hour on each side of it. If he succeeds in giving it the same degree of perfection as that which he has attained in the present instance, which is exceedingly probable, it will be indeed a proud achievement; his character is an assurance that it will be devoted, in the most unreserved manner, to the service of astronomy; while the energy that could accomplish such a triumph, and the liberality that has placed his discoveries in this difficult art within reach of all, may justly be reckoned among the highest distinctions of Ireland.

Lond. and Ed. Philos. Mag., Jan., 1842.

Lieutenant Becher's Horizon for Astronomical Observations at Sea or on Shore. Made by Carey, *Optician, Strand.*

The following is a representation of the sextant, with horizon attached to it for observation:

Directions for attaching the Horizon to the Sextant.

1. Unscrew the cover of the small conical cistern *b*, without removing it from its case, and see that the surface of the oil† in it is *rather higher* than the aperture communicating with the inverted cistern into which the oil is to flow, when holding up the arch of the sextant to read off. Leave the cistern in its place.

2. Take the sextant from its case, and screw the telescope into its place.

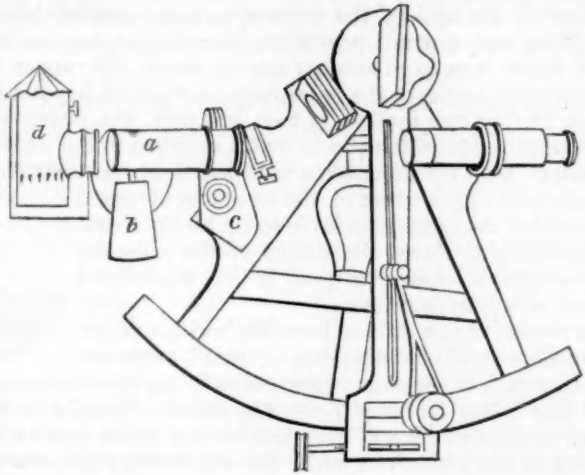
3. Fix the tube *a*, containing the horizon, in its place on the sextant, at the back of the horizon glass, the feet at the back of the plate being inserted in their sockets, and secure it there by means of the screw *c*. Raise the sliding screen at the end of the tube *a* to a proper height, so as to admit a sufficient degree of light to the tube.

4. Hook the cistern *b* in its place at the side of the tube *a*, previously immersing the pendulum in the oil which it contains. Be careful that the pendulum is previously allowed to shake about as

* In its original state, not as improved by the more perfect means latterly employed by Sir John Herschel.

† Oil of Almonds.

little as possible. The intention of immersing the pendulum in the oil, is to enable the observer to control its movement, which, from the extreme delicacy of its suspension, would otherwise be impossible.



5. If at night, and the lamp *d* be required, having lit the lamp,* if the light be too strong, it may be subdued by placing a screen of paper, or two if necessary, over the colored glass inside its cap, which may be unscrewed for the purpose. There is also a sliding screen† at the end of the tube *a*, which, by being moved up or down, assists in preventing too much light from passing up the tube. The light of the lamp with this also may be reduced to a sufficient strength, so as not to overpower the rays from the moon, or star, on the horizon glass of the sextant. A greater degree of shade may be necessary in bringing down the moon, or star, than afterwards for observation. The lamp being ready, slide its leg into its place at the back of the inverted cistern. The lamp will then hang in its proper place for the observation, and on holding the arch of the sextant up to read off, will preserve its vertical position.

The face of the sextant must never be inclined downward while the horizon with its cistern is attached, as in that case the oil will be lost from it.

Method of Using the Instrument.—In the construction of the horizon it is assumed that when an observation is made with the horizon of the sea, that horizon forms a diameter to the field of the telescope, the sun being seen on it as in the adjacent figure. The long axis of the telescope fixed in the instrument, would then

* Four threads are sufficient for the wick.

† This screen being raised or depressed regulates the degree of light also for day observation, and at a proper height will prevent a burr on the horizon arising from too much light.

be horizontal, but for the known angle of the dip of the horizon, by which the altitude is corrected. The same position of the telescope is thus obtained:—A line for the horizon formed by the upper edge of the slip of metal, at right angles to the plane of the instrument, and in the plane of the axis of the telescope, was assumed beyond the horizon glass, and a small pendulum, carrying an arm at an angle of 90°; to which was fixed another slip of metal, the upper edge of which is at right angles to the pendulum, was placed beyond it. The pendulum having free motion in any direction, the observer has to bring the upper edge of the slip of metal attached to the pendulum in exact contact with the line above mentioned, or in other words, he has to bring the upper edges of the two slips of metal into one, and at the same time he is to make his observation by bringing down the image of the reflected object which he is observing upon it. If that object be the sun, it will appear thus:—

As the observer has thus to form his horizon at the instant of observation, in observing on board, he should get into that part of the ship where there is the least motion, and *especially in a place screened from the wind.* He may be seated or not, at pleasure, but he will find that he has more control over the movement of the pendulum when the arm holding the instrument is supported on his knee, or by some convenient part of the vessel. In observing *on shore*, he must also be careful to *screen himself from the wind.*

The observer will readily see when the upper edge of the slip of metal is below the line of the horizon, and by altering the position of the instrument, can bring the former up to the latter; but as the metal slip would prevent the horizon line being seen when the upper edge is above it, a small piece has been cut out of it, or, in other words, a notch, or aperture, has been made in this edge, so that the observer can see the horizon line in that aperture, when the horizon line is below that edge, and can rectify it by again altering the position of his instrument.

It may be right to state here that the great precision attainable with this horizon, may be attributed to the application of the lens at the end of the tube, next the horizon glass, which allows of the magnifying power of the telescope being used for the observation.

Naut. Mag. Aug. 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Press;* William C. Van Hoesen, Catskill, Greene county, New York, April 2.

A shaft runs across the frame of this press, and on each end of it there is a scroll wheel, which receives a chain, or rope, that passes

around a pulley at the top of the frame, then under another pulley, attached to each end of the follower, and is then made fast to the upper part of the frame. On one end of the shaft of the scroll wheels there is a large wheel, called the "power wheel," from which a chain, or rope, passes to a capstan, or other first mover.

The claim is to the "combination of the power and scroll wheels."

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2. For an improvement in the *Current Water Wheel* for Mills; Noadiah N. Hubbard, Randolph, Portage county, Ohio, April 2.

This patent was obtained for an improvement in the manner of applying chutes to the spiral current wheel. Heretofore two chutes have been placed at the forward part of the screw, so as to concentrate the current; but in all cases the current thus concentrated has been thrown upon the first thread of the screw, and the present improvement is in so placing these chutes that the current shall be directed upon different parts of the length of the thread. The patentee says: "I am aware that the force of the current to be thrown upon a wheel has been increased by chutes placed at an angle with the axis of the wheel, so as to concentrate the current upon it, and this I do not, therefore, claim as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the employment of two or more sets of chutes, or regulators, in combination with a spiral wheel, so as to throw the current upon different parts of the thread, or spiral, along its length, as described."

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3. For a method of *Wetting Flannels and other Cloths* previous to Scouring or Milling; Joseph W. Hale, Haverhill, Massachusetts, April 2.

A colander, pierced with numerous small holes, is attached to a reservoir, or tank, of water, by means of a pipe, the orifice of which is regulated by a valve, to which a cord is attached having a weight at its opposite end, for the purpose of keeping the valve opened when desired. A roller is placed at one end of the frame, and two at the other end, and the cloth in going from the single roller to the double set, by which it is drawn through regularly, passes under the colander and receives the spray from it.

The claim is to the combination of the tank, or reservoir, valve, rollers, and the colander.

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4. For improvements in the machine for *Cutting Crackers;* William Perkins, Boston, Massachusetts, April 2.

A shaft that runs across the frame of the machine gives motion to another shaft, on which is a segment cog wheel that takes into a cog wheel on an under feed roller, and from this motion is communicated to the upper feed roller, and the apron that carries the dough under the stamping apparatus, and conveys the cut crackers from under it. As the wheel that communicates motion to the under feed roller has cogs only on a part of its circumference, the dough will be fed at in-

tervals, and those intervals are made to correspond with the time required to stamp the crackers, which is effected by a cam on each end of the shaft of the segment wheel, said cam actuating a lever connected, by a rod, with a toggle-joint that operates the stamping apparatus.

The claim is to "the arrangement of machinery which gives motion to the feed rollers and endless apron, in combination with the arrangement of machinery which operates the stamping apparatus; and also to operating the feed rollers and endless apron, so that they may be alternately at rest and in motion, by means of a geared pinion, having a portion of the teeth of its circumference removed, in connexion with the other machinery intervening between said pinion, feed rollers and apron; also operating the stamping apparatus by means of a cam or cams, in connexion with the toggles and other intervening machinery."

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5. For an improvement in the *Tuyere for Forges;* Elias Kaighn, Camden, Gloucester county, New Jersey, April 2.

The ash box of the forge is to be surrounded by a flue, which has an opening to receive the nose of the bellows, and the blast passes from the flue into the ash box, through apertures made in the sides thereof, and from the ash box into the fire, through holes made for that purpose in its top plate; the ash box has a bottom which is removable at pleasure.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the construction of the tuyere with a flue surrounding the ash box, in combination with said ash box, as set forth. Also, in combination with the foregoing, the arrangement with the upper surface of the tuyere, as the hearth of the forge, and the perforated cover for admitting air to the flame, &c., as set forth."

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6. For a *Cattle Pump;* Shively Stadon, Greenwood, Columbia county, Pennsylvania, April 2.

The patentee says:—"In my apparatus the weight of a single animal, or of more than one, is made effective in the raising of water, by their standing upon a movable platform, close to which the trough is situated, from which they are to drink, said platform being so connected with a pump as that by its depression it shall operate upon the pistons of the pump, and of course give a supply of water."

The claim refers throughout to the drawings, and is confined to the special arrangement of the apparatus, as described and represented.

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7. For a mode of *Healing Reducible Hernia;* Zophar Jayne, M. D., Greene county, Illinois, April 2.

The claim affords a sufficiently clear description of the improved mode of healing reducible hernia, and is in the following words:

"What I claim as my invention, and desire to secure by letters patent, is, first the injecting into the hernial or peritonial sac, or into the common cellular membrane, or parts in, at, or about, the abdominal

or femoral rings, or openings, wherever the hernia may occur, of an essential oil, or other stimulating or exciting fluid, for the purpose herein fully set forth, whether the same be done or injected by means of the syringe herein described, or by any other instrument adapted to that purpose; and secondly, I claim the constructing and using of a syringe for the above purpose, having a sharp-pointed beak, and a lateral opening therein, substantially as described.

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8. For an apparatus for *Heating Water and Steaming Vegetables;* Asa Munger and James S. Marsh, Auburn, Cayuga county, New York, April 2.

This apparatus consists of a boiler made of two concentric cylinders, the space between the two being for the water, and the furnace being arranged within the inner cylinder. A tubular worm is coiled within the first chamber, its upper and lower ends opening into the boiler. Two tubes branch off from the boiler, one from the top and the other from near the bottom, and connect with the bottom of a tub, from which the steam is conveyed, by a pipe, to the steaming apparatus.

Claim.—"We do not claim to be the inventors of the worm in the fire chamber, nor of the combination of the tub and boiler, without the worm, but what we do claim as our invention, and desire to secure by letters patent, is the combination of the worm in the fire chamber with the boiler and tub, for the purpose and in the manner set forth."

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9. For an improvement in the *Joints of Spectacle Frames;* Thomas Eltonhead, Baltimore, Maryland, April 2.

"It has heretofore been the practice in forming the frames of spectacles of metal to divide the end-pieces, which are soldered to the rims containing the glasses into two parts, and to connect these two parts together by means of a screw. The joint pin has been affixed to one of these parts, and the side, or temple pieces, have had the tubes through which the joint pin passes soldered to them. In my improved construction I make the end pieces solid, instead of dividing them into two parts, and into this solid piece I file a notch, to receive the end of the temple piece, which is to be adapted thereto, and a hole drilled through for receiving the joint pin."

The claim is to this manner of forming the joints, which not only abridges the labor in making them, but leaves the metals in a condensed state, it not being heated after, having been hardened under the hammer. The glasses are to be snapped in like watch glasses.

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10. For improvements in *Corselets for Medical purposes;* Alanson Abbe, Worcester, Massachusetts, April 2.

The patentee informs us that "the corselet consists of a back piece, and two side pieces, which are united to, and open from, the back piece by a hinge of metal, cloth, or other material, fixed at the top,

and in front are laced with strings. These are made, when connected, to enclose the breast, shoulders, and the upper part of the back, and are adjusted to the shape of the wearer, so as to represent the figure of the body of a well formed person. The corselet affords a support to the frame, and may be advantageously used to prevent, or remedy, distortions of the spine or chest."

The respective parts of the corselets are formed in a mould of metal, wood, plaster, or other suitable material, of the desired form. The claim is to the "mode of manufacturing corselets by forming them of any suitable material upon a mould, or between double moulds, as specified."

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11. For an improvement in the *Cheese Press;* Job Arnold, Harmony, Chataque county, New York, April 2.

The bed of this press is movable, as is also the follower. The bed slides up and down, and has a cog wheel, or pinion, at each end, the axes of which wheels have their bearings in the bed; these wheels gear into two permanent racks attached to the sides of the frame, and as the bed of the press slides up and down, the cog wheels, or pinions, are turned by the racks. There are two levers under the bed, and two above the follower of the press. The levers above, and those below, are connected together by rods, or links, joined to one of their ends, the other end of each pair being connected, by means of ropes, or chains, with the arbor of the cog wheel on each side of the bed. The fulcra of the upper levers are in the follower, and those of the lower, in the bed of the press. The result of this arrangement is, that any weight placed on the movable, or sliding, bed, will cause it to descend, which will turn the wheels, and by means of the ropes, or chains, on their arbors, the ends of the levers to which the chains are attached are drawn together, and as their opposite ends are connected together, the follower is forced down upon the cheese, or other articles placed on the bed.

Claim.—"What I claim as my improvement, and wish to secure by letters patent, is the combining of two sets of levers, one set being arranged above the follower, and the other below the movable bed, or press bottom, with the aforesaid follower and movable bed, and said levers being connected and operated as set forth."

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12. For improvements in the *Rotary Steam Engine;* Isaac N. Whittlesay, Vincennes, Knox county, Indiana, April 2.

"The general construction of my improved engine," the patentee says, "is similar to that of some others which have been heretofore constructed, but I have made such improvements thereon as are intended and calculated to obviate some of the difficulties which have been experienced in its action. The principal of these improvements consist in the employment of the steam to open and close the sliding valves, and in the arrangement of some of the other parts by which its action is governed."

Within a hollow case, of the usual construction, "revolves a drum, which carries two valves, to be operated by the action of the steam, which action causes the said inner drum, with its shaft, to revolve in the ordinary way. The valves, which are connected together by a rod, slide into recesses made for them in the drum, which is hollow towards the shaft, for the reception of a disk attached to one of the heads of the outer drum. This disk is at some distance from the head plate to which it is attached, and the space between them is divided by a partition, so as to divide the induction from the eduction pipes. The steam introduced through the induction pipe passes into the hollow space of the inner drum, acts against the inner end of one of the valves, which is thus forced out, and then passes through a hole by the side of the valve into the steam chamber, and impels the valve and inner drum by its reaction on a stop attached to the inner periphery of the outer drum. The openings which admit the steam into, and allow it to escape from, the drum, must be so regulated as to correspond with the position of the stop. The steam may be made to enter the space between the two drums on either side of the valves by a shifting plate, which opens an aperture on one side as it closes the one on the other side, so that by shifting this plate, the motion of the engine may be reversed. The claim refers throughout to the drawings. It is confined, however, to the manner of protruding the valves by the elastic force of the steam, acting behind them by an arrangement of parts similar to that above described; and also to the manner of reversing the motion of the engine, by shifting the plate, as above indicated.

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13. For an improvement in the machine for *Cutting Staves;* Cephas Manning, Acton, Middlesex county, Massachusetts, April 10.

This machine cuts the staves from a block of wood by means of a knife, or knives, attached to two revolving disks on a shaft. Between the knife and the shaft there is a bar, extending from disk to disk, on which two holders are placed, armed with the necessary cutters for forming the bevel and groove, and for cutting off the ends of the staves. The position of these holders may be shifted on the bar, so as to adapt them to any length of staves, they being made fast by means of a set screw. The bar should be so situated, with reference to the cutter, which separates the stave from the block, as to cut the bevel, &c., before the stave is cut from the block.

The block is moved forward by means of levers, palls, and a ratchet wheel, which need no description, and these are so arranged as to be thrown in and out of gear, at pleasure, by the aid of levers and catches.

Claim.—"I claim the arrangement of the holders of the cutters for forming the bevel and groove, and for cutting off the ends of the staves, on curved or straight bars, or similar contrivances, so that they may be adjusted to cut staves of different lengths, and preserve the bilge of the stave, as described."

The particular arrangement of the machinery by which the pall and ratchet wheels are thrown out of gear, is also made the subject

of a claim, but this we omit, as the drawings would be necessary to an understanding of it.

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14. For improvements in *Lamps* for burning Chemical mixtures, or compositions of Alcohol, Spirits of Turpentine, &c.; Benjamin F. Greenough, Boston, Massachusetts, April 10.

The claims express the character of the improvements sufficiently to enable any one acquainted with the construction of lamps to understand them. They are as follows:

"Having described my invention, I shall claim—first, the placing of a shoulder on the rod by which the button is supported, said shoulder being so constructed as to set loosely on, and adapting the button to a projection on said shoulder in a similar manner, by means of which combined arrangement, the rapid oxidation of the disk (which is made of platina,) is prevented, as described. Second, guiding the adjusting rod of the button, by passing the same through a tube, whose lower end is attached to the bottom of the oil cup, or otherwise similarly arranged, the said tube extending upwards into and through the central part of the interior of the burner, the whole being for the purpose of permitting an uninterrupted current of air to act on the inner surface of the flame. Third, the combination of an adjusting cone (applied to the exterior tube of the burner by a circular spring, or other contrivance substantially the same, by which its altitude is regulated,) with the adjusting button, or one whose elevation may be varied at pleasure; the whole being arranged substantially in the manner and for the purpose described. Lastly, I claim a cone constructed with an extended cylindrical base, having a series of radial holes through the circumference of the same, and made so as to be adjusted in height on the exterior tube of the burner by means of a circular shelf and spring, in combination with a movable button, whose rod is supported and guided by a tube, connected with the oil cup, and whose elevation can be regulated by a screw, or other suitable contrivance, the whole being constructed and arranged for the purpose and in the manner described."

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15. For a machine for *Harrowing and Planting Seed;* John F. Schermerhorn, and Rufus Porter, City of New York, April 10.

In an appropriate frame there is a cylinder, armed with several rows of curved teeth, which enter, and carry up, the earth, and this is knocked off by the teeth of a smaller cylinder, which pass between the sets of teeth on the main cylinder. At a short distance back of the said small cylinder, there is a planting cylinder, hoppers and coverers, to contain, drop, and cover the seeds. For the purpose of lifting the forward part of the machine, to clear the teeth from the ground, there are two shoes jointed to the frame, and to two levers that are connected together by a bar, by which arrangement the shoes may be pressed down and made to lift the machine.

Claim.—"What we claim as our invention, and wish to secure by letters patent, is combining the large, or cutting, cylinder, and the re-

volving shaft of spiders, arranged as set forth in an open frame, so constructed as to allow of their application to the purpose specified, and described. We also claim, in combination with the foregoing, the hoppers and planting cylinders, the whole being constructed as described. Lastly, we claim, in combination with the cylinder and shaft of spiders, arranged as set forth, the mode of raising the frame and cylinders from the ground by means of the shoes and levers; the whole being combined, arranged, and operating substantially as described."

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16. For an improvement in the *Truss* for the cure of Prolapsus Uteri; John A. Campbell, Lima, Livingston county, New York, April 10.

There is in this truss a body spring, of the usual construction, furnished with a back pad. The abdominal pad is connected with the body spring by means of a semi-elliptic spring, which is attached to the rim of the pad at one side, permanently, and at the other by a screw which passes through a slot in the elliptic spring, so as to allow play thereto. To the middle of this semi-elliptic spring, and to the upper part of the pad rim, is attached the adjusting plate, which forms the connexion with the body spring, the screw which connects them being passed through a slot in the said plate, for the purpose of adjustment.

Claim.—"I do not claim as my invention either the abdominal or the back pad, neither do I claim the body spring; but what I do claim as my invention, and desire to secure by letters patent, is the arrangement of the semi-elliptic spring and the spring adjuster, in combination with the abdominal pad, body spring, and back pad, for the purpose of regulating the pressure of the abdominal pad, constructed and operating as described."

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17. For an improvement in the *Window Blind Fastener;* Sylvanus Fansher, Southbury, New Haven county, Connecticut, April 10.

This apparatus consists in part of a bar, which is jointed to the shutter, near its hinged edge; the outer end of this bar has a loop which passes on to staples attached to the window sill, and to the shutter—those on the shutters are near the edges that lap over each other, and correspond, when the shutters are closed, with two on the sills, so that the loop on the end of the bar may pass over and embrace the two, and thus secure the shutters. When it is desired to keep the shutters open, the loops on the bars are passed on to staples near the sides of the window.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the above described mode of fastening window shutters and blinds, which consist of the bar attached by a joint to the shutter, in combination with the two sets of staples on the window sill, and the one set on the shutters.

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18. For an improvement in the method of *Casting Hinges;* Samuel Wilkes, Darleston, Stafford county, England, April, 10, 1841. Patent to run fourteen years from the 21st of January, 1840, this being the date of the English patent.

This patent is for a mode of casting the two sides, or flaps, and the hinge joint on to an axis at the same operation. A wrought iron joint pin is put into the mould, and, in casting, the metal is prevented from running together at the joints, by iron or paper washers slipped on the joint pin; and the junction of the leaves between the joints is prevented, by means of iron clips, put into the flasks.

Claim.—"What I claim is the mode of manufacturing hinges, by casting the two flaps, or sides, with their hinge joints at one time, on to a suitable axis, as described."

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19. For an improvement in the machine for *Pressing Straw Braid;* Henry H. Robbins, Middleborough, Plymouth county, Massachusetts, April 10.

For an explanation of the leading features of this improvement, we refer to the claim only, which is in the following words, viz:—"I claim as my invention," says the patentee, "pressing straw braid by means of a polished revolving metallic wheel, or roller, in combination with a hollow metallic box, the upper side, or face, of which is concave and polished, and which is heated by the introduction of steam, the concave face being pressed against the periphery of the wheel by means of a bent lever and weight."

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20. For an improvement in the *Screw Propeller,* for propelling Boats, Vessels, &c.; Ebenezer Beard, New Sharon, Franklin county, Maine, April 10.

A description of the peculiarities of this improvement could not be rendered clear without the drawings; but the claim will enable those who are acquainted with the screw propellors heretofore made, to understand this modification.

Claim.—"I shall claim" "curving the wings of the screw paddles, or propellers, in a direction perpendicular to the shaft, or axis, of revolution, as described."

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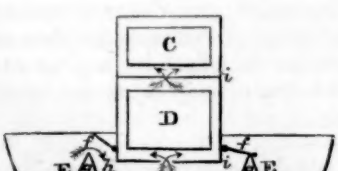
21. For improvements in the *Cooking Stove;* M. C. Saddler, Brockport, Monroe county, New York, April 10.

In this stove there are two fire chambers, A A, (see diagram,) placed side by side, and two ovens, C D, one above the other, and placed above the fire chambers, the side flues of the oven being above the middle of each fire chamber, and that portion of each fire chamber which is not covered by the ovens, is provided with boiler holes in the usual way. The bottom of the lower oven



is protected from the action of the fire by a cold air flue, as will be seen by reference to the diagram, at E E, the bottom plates of which are curved down where they meet in the middle between the two fire chambers, and leave but a narrow space, *k*, between them and a projection from the bottom plate of the fire chamber. The valves, or dampers, *f*, *f*, are hinged to the side plates of the ovens, and bear, when closed, on the top of hollow valve seats *g*, *g*, through which cold air circulates, for the purpose of protecting them from the injurious action of the fire; but when the dampers are open, a flue is formed by the surface of the damper, the top plate of the fire chamber, and the side of the oven, as at *h*, into which cold air is admitted for the same purpose.

Between the top plate of the cold air chamber and the bottom of the lower oven, and between the top of the bottom, and the bottom of the top oven, there are guard plates, *i*, *i*, which admit the draft under the middle of the bottom of the oven. Fire can be made in one or both fire places; when one only is used, one of the dampers must be closed.

Claim.—"I do not claim to be the first to have constructed a cooking stove with two fireplaces, or chambers of combustion, in either or both of which fire might be made, this having before been done, but not under an arrangement and combination of parts similar to that adopted by me; but what I do claim in the above described stove, and desire to secure by letters patent, is the manner of constructing and of placing the cold air flue between the chambers of combustion and the ovens situated above and between said fire chambers, as herein set forth. I claim, likewise, the making of the valve seats hollow, and the admitting of air into them, in the manner and for the purpose described; and also the protecting of the dampers, by constituting the spaces formed by them, when opened, into cold air flues, in the manner set forth. I also claim the manner of arranging the oven flues as described—that is to say, the dividing of the bottom flue plates, which I generally denominate the guard plates, into two parts, so as to cause the heated air to enter the flues along the middles of the bottom oven plates, and to ascend on each side of the ovens, as herein made known."

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22. For improvements in the machine for *Planting Corn*, Sugar Beet, and other seeds; Ezra L. Miller, Brooklyn, New York, April 10.

On the forward end of the frame of this machine, and at each side of it, there is a hopper, furnished with a slide for receiving and dropping the seeds. The slides are connected by a small chain with a spiral spring, inclosed in a tube, which draws back the slides after they have been pushed forward by cams on the wheels of the machine, which strike against a lever in connexion with each slide. When the slides are relieved from the cam, they are drawn back by the spring, and strike against a stop, which gives a jar to insure the dropping of the seeds. The strike, which brushes off the surplus seeds from

the top of the slide, as it is moving forward to drop them, is composed of a number of strips of quills, held together in a clamp. An agitator is employed to insure the entrance of the seeds in the hole in the slide, and to prevent them from arching over, which consists of a rod, with a brush at one end, which is jointed, and by means of a rod, or standard, attached to, and moving with, the slide and a connecting rod, this brush, or agitator, is moved over the hole in the slide.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is—first, the manner in which I have combined the reciprocating slide, the stop, the cams on the wheels, and the spring, or springs, by which the slides are operated; by means of which combination, an alternately slow and rapid motion is given to the reciprocating slide, by the sudden arresting of which against the stop, a concussion is produced when the seed vessel is directly over the dropping tube, which insures its falling. I also claim the particular construction of the spring strike, formed of elastic quills, and affixed and operating substantially as described. I also claim the manner of constructing and operating the agitator, as described."

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23. For a mode of *rendering Casts and other articles Water and Air Proof;* Samuel Goodwin, city of New York, April 16.

This invention "consists in making any article that can be cast, or moulded, perfectly impervious to air, moisture, or decay, by saturating it in a heated composition of oil and rosin. What I claim as my invention, and desire to secure by letters patent, is the mode of rendering articles manufactured from cement, composed of the materials specified, (sand and plaster of paris,) or any others substantially the same in their combination, impervious to air, moisture, or decay, by boiling them in a mixture of oil and rosin, as described." Casts of plaster of paris, and its compounds, have often been saturated with wax, drying oils, and varnishes, and in what particular the proposed process differs from these, we do not know, except it be in the *boiling*, which, we apprehend, will be apt to decompose the plaster, by separating from it its combined water.

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24. For an improvement in the *Indicator, or Steam Gauge*, for ascertaining the pressure of steam in a boiler; George Bradley, Paterson, Passaic county, New Jersey, April 16.

This apparatus consists of a piston, which works in a cylinder open at one end to the atmosphere, and at the other to the steam in the boiler, and this is connected, by a slide, to a spring balance, provided with a graduated scale and pointer, to indicate the pressure of the steam in the boiler above that of the atmosphere.

Claim.—"What I claim as my invention, and not previously known nor used, is an oscillating piston, to which is attached a metallic spring, in such a manner as to counterbalance any pressure that may be communicated from the steam boiler to such piston, and at the same time show what that pressure is by means of an index."

25. For an improvement in the *Cooking Stove;* John B. Bissell, Otsego, New York, April 16.

This stove has two fire chambers—one in front of, and the other above, the oven. When the front alone is used, the draught passes, by means of raised flues, under the boilers, through the upper fireplace, and out at the stove pipe; or, by means of a rolling damper, which closes the opening to the upper fireplace, and at the same time opens the flues around the oven, it may be carried down in front of the oven, under it, and then up the back, to the stove pipe. The draught from the upper fireplace may pass either directly out of the stove pipe, or down the back of the fireplace, over the oven, down the front, under the bottom, and up the back, to the stove pipe.

Claim.—"I do not claim the invention of the raised collars, or rolling or slide dampers, or either of the fire chambers, they, severally, having been used before, in different stoves; but I do claim as my invention and improvement, the method of arranging and combining the upper and lower fire chambers with each other, and with the flues around the oven, by means of flues governed by dampers."

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26. For improvements in *Saw Mill Dogs;* Damon A. Church, Friendship, Alleghany county, New York, April 16.

In this case we omit the claim, as it refers throughout to the drawings, and could not be understood without them. It is limited to an arrangement of levers for withdrawing the dogs by the motion of the carriage, and also to a particular arrangement of the parts for setting the log.

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27. For an improvement in *Knife Handles;* Zena K. Murdock, Meriden; New Haven county, Connecticut, April 16.

The subject of this patent is a new mode of making handles for table cutlery, from plates of ivory instead of from solid pieces. Four such plates are to be put together by tongues and grooves, and held in place by a cap at the back end, and by a ferule at the end which receives the knife or fork.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode or method of constructing handles for table cutlery from plates of ivory, or bone, &c., combined substantially in the manner specified."

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28. For an improvement in the machine for *Cleaning and Drying Feathers;* Nathaniel L. Manning, Boston, Massachusetts, April 16.

The patentee says: "I shall claim as my invention the mode herein described of drying and cleansing feathers, by means of carbonic acid gas, hot air, and other products of the combustion of charcoal, or other suitable fuel, introduced among the feathers during the process of whipping and separating them from each other, in the manner described. Second, I claim whipping and separating the feathers from each other, by means of bows and sails applied to a revolving shaft,

which shaft shall remain in one position, while revolving, and the feathers be brought under the action of the same, in the box in which said shaft revolves, in any convenient manner, or said shaft may be moved over the mass of feathers, and back and forth throughout the box, by means of a band and pulley, or a chain belt and cogged pinion, operated as above described. Third, I claim closing the elongated slots, or apertures, in the sides of the box, so that none of the feathers may escape, or impede the operations of the machinery, as the revolving shaft is moved to and fro, by means of a band laying over the same, and traveling over drums, or pulleys, and operated by the revolving shaft, as set forth."

We deem it unnecessary to add any explanatory remarks, as the alleged improvements are sufficiently pointed out in the above; we have no doubt that this machine will be equally good with some of the previously patented feather dressers, which have had their day, and are almost forgotten.

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29. For an improvement in the *Screw Wrench;* Loring Coes, Springfield, Hampden county, Massachusetts, April 16.

The following is the claim made under this patent. "Having thus described my invention, I shall claim combining the screw, which operates the sliding jaw (and which is placed on one side of the shank upon which the said jaw moves, and to the extremity of which the hammer jaw is applied;) with a female screw formed through a projection from the sliding jaw, situated on the same side of the shank with the adjusting screw; the said adjusting screw to be suitably supported, and to have a turning, or milled, nut thereon, a portion of whose edge, or periphery, shall pass into a notch or other similar contrivance, formed in, or upon, the side of the shank of the wrench, so that the said adjusting screw may be always kept in the same position, and when revolved, cause the lower jaw to slide on the shank, as described."

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30. For improvements in the *Pump;* Jesse Reed, Marshfield, Plymouth county, Massachusetts, April 16.

Claim.—"Having described my improvement in pumps, I shall claim: First.—The method of confining the lower valve to its seat, so that it may be easily removed therefrom, for repair or other purpose, by means of a spring, to which the valve is connected, and which rests on the upper surface of the bottom of the pump barrel—its end pressing against the interior circumference of the barrel, the same being arranged and constructed substantially as described. Second.—I claim the particular mode, above described, of constructing a pump, with an air chamber below the lower box, into the bottom of which chamber the pipe communicating with the cistern, or well, is inserted, or connected, in any proper manner, and through which chamber another pipe passes, the lower end of which is situated immediately over the top of the induction pipe, while the upper

end is joined, or connected, to the top of the chamber, the said pipe communicating at top, with the pump barrel, the lower valve of the same being immediately over and upon its ends, and at bottom, by any sufficient number of holes, or orifices, bored through the same, with the said chamber, through which it passes, the whole being arranged substantially as described, and for the purpose of permitting the water, from the cistern, or well, to rise into the chamber during the downward stroke of the piston, or upper box, and otherwise operating in manner as herein before explained and set forth; meaning in the above, not to claim the addition of an air chamber to the lifting pump, but my particular mode of constructing and applying the same, as described. Third.—I claim the method of adjusting the pump handle, or lever, which raises and depresses the upper pump box, by attaching said lever to the top plate, or cover, of the pump barrel, and arranging said plate, or cover, as described, so that it may be turned around, and fixed in position by a screw or other similar, or suitable, contrivance, the whole being constructed and operating substantially as described."

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31. For an improvement in the *Dyeing Machine;* William Spencer, Lowell, Middlesex county, Massachusetts, April 17.

This improvement in the dyeing machine has been added to a patent granted on the 25th of September, 1838, noticed in this Journal, vol. xxiv, 2nd series, page 168; for an explanation of the principle of the machine, the reader is referred to that article.

Instead of one vat, as described in the original patent, there are to be several successive vats, and a slatted reel for each vat, said reels being so arranged that, by means of counter weights, cords, and pulleys, they may be drawn out of the vats. The yarn passes from the beam over a small slatted reel on the edge of the vat, down through the dyeing liquor under the slatted reel, then up over another small reel on the other edge of the vat, then through a comb down under a reel between the vats, over a small reel on the edge of the next vat, and so on through the series. When the operation commences, the liquor being strong, some of the reels are drawn out, so that the yarn is not passed through all the vats, and as the dyeing liquor becomes weaker, the reels are let down into the vats, one after the other. The yarn is passed under reels between the vats, to expose it to the action of the atmosphere. The claim made is to the variations in this arrangement, from those described in the original patent.

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32. For an improvement in the manner of constructing the rods of *Lightning Conductors;* Justin E. Strong, Boston, Massachusetts, April 19.

The claim made under this patent is to "the mode set forth of connecting the joints of lightning conductors, and constructing and applying the discharging points thereto; that is to say, by forming each point with a shoulder and a shank in rear of the same, the said shank

having a screw cut on the same, and passing through one of the rods, and being screwed into the other, the whole being arranged and applied to a building as described."

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33. For an improvement in the *Smut Machine;* William B. Palmer, Rochester, Monroe county, New York, April 19.

In this machine, two frustrums of cones, made of perforated sheet metal, are arranged one within the other, the interior frustrum being made to revolve. The upper surface of the head of the inner cone, and the inner surface of the head of the outer one, are fluted, for the purpose of rubbing the grain; and within the inner cone, there is a fan which revolves in a direction contrary to that of the cone. The grain is fed in from the top and rubbed between the surfaces of the two cones, and is at the same time subjected to the action of a current of air, created by the fan.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following improvements, viz: The combination of the fan with the cones, in the manner set forth; the internal cone being perforated, and constructed with a fluted head, and having the fan arranged and moved within it, as described; also the combination of these, so constructed and arranged, with the external cone."

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34. For an improvement in the *Screen for Sifting Coal;* Elisha D. Payne and Enos Woodruff, Newark, Essex county, New Jersey, April 19.

The patentees say,—"Our improvement consists in a new method of hanging the sifting box by means of two gudgeons, or by a single rod, or axle, and providing a guide board on the sifting box, to guide the material to be sifted on to the head of the screen. We give to the screen a peculiar shape, which forms the under part of the sifting box, and incline it from its head to its delivery end to suit the nature of the material sifted. The axle, or gudgeons, we place about one-third of the way from the head of the sifting box to the tail, or delivery end, and we agitate the sifting box by raising or depressing the one end, by means of a cam toothed wheel, with a spring at the other end to return the motion against the toothed wheel, so that it is vibrated vertically, like a tilt hammer."

"What we claim, is combining the inclined guide board with a box, or case, for receiving the material to be sifted, constructed as described; said box consisting of side and end pieces, and an inclined bottom, pierced with apertures for sifting the coal, or other materials, the whole being arranged as set forth. Also, in combination with the sifting box thus constructed, an exterior case for containing the same. Lastly, in combination with the sifter box and external case, the method of suspending and operating the shoe by means of the axle, the spring, and wheel, the whole being constructed and operating in the manner set forth."

35. For an improvement in the *Seal Press;* A. Ralston Chase, Cincinnati, Ohio, April 19.

In this press the seal is to be attached to a guide rod, around which is coiled a helical spring, for the purpose of drawing up the guide rod and seal, after they have been relieved from the action of an eccentric, or cam, on the end of a hand lever, by which the impression is given.

The claim is confined to the "combination of the lever, having an eccentric formed on its end, with the guide rod, and helical spring, as described." The difference between this seal press and many others previously in use, is very small, and its superiority to them by no means obvious.

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36. For an improved mode of producing a *Black Color for Dyeing;* John D. Prince, Lowell, Middlesex county, Massachusetts, April 24. (See Specification.)

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37. For an improvement in the *Spring Lancet;* John M. Van Osdel, Chicago, Cook county, Illinois, April 24.

The stem of the lancet which is the subject of this patent, is jointed to the back part of the inside of the case, and by means of two bridle pieces, it is connected to one end of a rod, which passes out through the back of the case; and around which is coiled a helical spring, for the purpose of drawing back the said rod. The two bridle pieces constitute what is called the "toggle joint," the vibration of which from one side to the other, which is effected by means of the rod and spring, will cause the lancet blade to advance so as to enter a vein, and then recede. The lancet is set by means of a nut on the rod which regulates the amount of vibration of the toggle-joint.

"What I claim as my invention, and desire to secure by letters patent, is the giving a reacting motion to the blade of a spring lancet, by the combination of the spiral spring and the compound cranks, or bridle pieces, as set forth. Also, I claim the method of setting the lancet by simply drawing back the rod, as described."

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38. For an improvement in *Boots and Shoes;* Ansel Thayer, Braintree, Norfolk county, Massachusetts, April 24.

"In boots and shoes as improved by me, there is not any outsole of leather from the instep to the back of the heel, this part being occupied by a plate, or fixture, of metal, which I denominate the metallic shank, which laps over the rear end of the outsole, and is continued back in one piece, so as to form a portion of the heel."

"What I claim as constituting my invention, and desire to secure by letters patent, is the employment of a metallic shank, extending along the instep and heel of boots and shoes, in place of the outsoles of leather, said shank being formed and affixed substantially in the manner set forth."

39. For a method of *Increasing the Draught of Chimneys;* Joseph Hurd, Jr., Stoneham, Middlesex county, Massachusetts, April 24.

Through the horizontal part of such a cowl as is usually employed on chimney tops, and which is provided with a vane to give it a proper direction, a horizontal shaft passes, which has a wheel on each end, that at the open end of the cowl being provided with radial vanes, parallel with the axis of the wheel, so that by its centrifugal action on the air, it tends to generate a vacuum in the chimney, and thus form a draught; and that on the closed side is provided with inclined vanes, against which the wind acts, and by which the whole is operated, or put in motion.

Claim.—"I shall claim discharging the smoke from a chimney, or the impure air of an apartment from the same, by a discharging wheel, constructed and revolved as described, and also by means of a cowl having a horizontal shaft passing through it, upon the front end of which a wind wheel is affixed, and upon the rear end, and over the mouth of the cowl, a discharging wheel, to be set in motion by the action of the wind on the former, the proper position of said cowl, with respect to the wind, being regulated by a vane suitably attached to, and which turns, the same, the whole being arranged and operating substantially as set forth."

There are several different cowls, or chimney caps, which operate to advantage when there is a good breeze of wind, but we do not know of one which is effective at any other time; they tend, in many instances, rather to obstruct than to aid the draught when the atmosphere is still; this, we apprehend, is unavoidable.

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40. For an improvement in *Iron Bridges;* Squire Whipple, Utica, Oneida county, New York, April 24.

The claim under this patent gives a sufficiently clear description of the nature of the improvement, and is as follows:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of sustaining the flooring of bridges by iron trusses containing cast-iron arches, formed in sections, or segments, in combination with diagonal ties, or braces, to sustain the form of the arch against the effect of unequal pressure, (with or without vertical posts, or rods,) and wrought-iron arch strings, or thrust ties, to sustain the thrust and prevent the spreading of the arch, in case the abutments and piers be not relied on for that purpose. Also, the divergence, or horizontal expansion, of the arch, from the middle portion to the ends thereof, in wooden trusses, or arches, as well as in those composed of iron."

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41. For an improvement in the *Window Fastener;* James P. McKean, Washington, District of Columbia, April 24.

The family of window fasteners is a very large one, not fewer than forty patents having been obtained for devices for this purpose; it would be no easy task, therefore, to compare a new comer with its

forerunners; this, therefore, we shall not attempt, nor shall we describe the features of that before us any further than they are given in the following:

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the bolt working through the lower rail of the shutter, near one edge, with the bar, or lever, having a handle (passing through to the inside of a shutter) near the other edge, for the purpose, and in the manner, described."

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42. For an improvement in the *Smut Machine*, for clearing grain from smut, garlic, &c.; James Coppuck, Mount Holly, Burlington county, New Jersey, April 24.

The outer case of this machine consists of a truncated cone, with the inside fluted, or channeled. The flutes, or channels, are made by alternate staves of about three inches at the greater diameter of the truncated cone, and gradually diminishing, and about an inch and a half deep at top, and gradually diminishing to nothing. A curved dish, with a hole in the centre, and a bridge tree, for the support of the spindle of the fan, is attached at the bottom, or small end, of the cone. A conical fan, with a cap, revolves within this case, the cap being equal, in diameter, to the larger inner diameter of the case; and the whole is covered with a semi-spherical cap, which is provided with a flue for every flute, or channel, in the case, through which the grain is fed. The current of air which moves from the smaller and towards the larger, meets the grain as it descends in the flues, and this, together with the action of the fans and flutes, or channels, separates the dirt, &c., from the grain.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of constructing the cylinder, or truncated cone, with flutes, as described, in combination with the revolving fan, or wings, acting as beaters, and to produce a current of air through the machine, the whole being constructed and operating substantially in the manner set forth."

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43. For an improvement in the *Winnowing Machine;* Zalman Rice, Lyons, Wayne county, New York, April 24.

In addition to the common blower, or fan wheel, of the well-known wheat fan, there is, in this machine, a second fan wheel, which throws a current of air downwards on an additional screen, or sieve, which at the same time receives a current of air from below, from the common fan wheel; below this sieve, or screen, two or more screens may be added at pleasure. "The screen is covered with wire that will admit the grain to fall freely through it upon a second sieve, or screen; as the upper sieve receives the wind directly on its upper surface, from the small fan wheel, the smut balls, white caps, and other matters which are larger than the grain, are thereby effectually blown off from it. Excepting towards its front edge, the lower side of the screen is defended from the action of the wind from the large fan

wheel, by a piece of thin wood, a sheet of metal, or other suitable substance, fastened on to the lower side of its frame, and extending from the back to within a few inches of the front of it. This piece I call a conductor, as it carries, or conducts, the whole of the grain to the opening through which it passes, and falls upon the screen below it."

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner of employing a second fan wheel, operating in a direction the reverse of that usually employed, so as that the current of wind from it shall be directed downwards in the manner, and for the purpose, set forth. I also claim the using of the device which I have denominated a conductor, on the lower side of the upper screen, and attached to the frame thereof, and also, if preferred, on the lower sides of the frames of the sieves, or screens, used for sifting, or screening, in such a machine as herein described and made known; said conductors being so placed as to adapt them to the carrying of the grain, or other matters, either backwards or forwards, according to the directions required by the inclinations given to such screens, or sieves."

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44. For an improvement in the *Saw Gin, for Ginning Cotton;* C. A. McPhetridge, Natchez, Adams county, Mississippi, April 24.

Instead of the grate bars in the ordinary saw gin, between which the saws pass, and draw the cotton, to separate the fibre from the seeds, they, in this machine, pass in grooves made for that purpose in a roller placed above the saw cylinder.

Claim.—"What I claim as my invention, and which I wish to secure by letters patent, is the peculiar arrangement of the roller, having grooves into which the saws work, in combination with the saws, for the purpose, and in the manner, described."

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45. For an improvement in the apparatus for *Destroying Canker Worms;* Daniel Newhall, Lynn, Essex county, Massachusetts, April 24.

This patent is for an improvement added to the patent granted on the 31st day of October, 1840, and noticed in this Journal, vol. ii, 3rd series, page 406.

For the purpose of preventing the oil, or other liquid, used in the trough for destroying the worm, from overflowing, in consequence of the percolation of water into it, there is to be an inclined pipe, the lower end of which reaches to the bottom of the trough, and the upper end within a short distance of the height of its edge. Sufficient water is first put into the trough to cover the end of the pipe, and the oil, or other fluid, is then poured in. When rain falls, and passes into the trough, the superabundant water will flow over at the upper end of the inclined pipe, and the oil thus be preserved from escaping.

Claim.—"Having thus described my improvement, I shall claim, as my invention, a pipe, or tube, arranged substantially as described, in combination with the trough, for the purpose of preventing the oil,

or destroying liquid, from being displaced, or forced out of the trough."

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46. For improvements in the *Cooking Stove;* Hiram Blanchard, Aquackamonk, Passaic county, New Jersey, April 27.

The improvements that constitute the subject of this patent, is in that kind of cooking stoves that have the oven back of the fire chamber, and an air chamber between the two. The guard plate which forms the false back of the fire chamber has a "cross piece," or flanch, projecting from it, that forms the bottom of the air chamber. The upper part of this guard plate is bent back to form the top of the air chamber, and its lower part bent forward to prevent coals and ashes from passing into the flue, under the oven. The upper part of the fire chamber is inclined forward, and provided with apertures and a register to carry off the smoke, &c., when articles are cooked on the hearth.

Claim.—"What I claim as my invention, and wish to secure by letters patent, is, 1st. Constructing the guard plate with a cross piece to form the bottom of the air chamber, in combination with the ver tical shield, or continuation of the guard plate, extended below said cross piece, for the purpose of preventing coals, &c., passing into the flue under the oven, the whole being constructed as before described. 2nd. Constructing the front of the stove with an inclination forward and above the hearth of said stove, in combination with the apertures governed by a register, as set forth, for the purpose of receiving the smoke, &c., when articles are cooked on the front hearth, or ashes, when the fire is raked, as described."

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47. For an improvement in *Piston Rods of Steam Engines;* John R. St. John, Cleveland, Cuyohoga county, Ohio, April 27.

The rod of the piston, which works in the cylinder, as described in the specification of this patent, is hollow, its outer end being attached to a slide, and in it there is a small hollow piston, to the rod of which the connecting rod, from the crank, is jointed. Two such must be employed, with two cranks placed at right angles. By this arrangement, a crank of greater capacity than the length of the cylinder may be employed. As a modification of this arrangement, the patentee proposes the connecting of the slide of the piston rod, by means of a toggle joint, with the slide to which the connecting rod is jointed.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of two or more compound piston rods working in appropriate cylinders, as set forth, with an equal number of cranks arranged on the shaft, to which the power is communicated, the whole being combined, constructed, and operating substantially in the manner, and for the purpose, described. The said compound piston rod being my own invention, but not claimed for reason of being effective only in a combination of two or more, as claimed and set forth."

Specifications of American Patents.

Specification of a patent granted to* John D. Prince, *Lowell, Massachusetts, on the 24th of April,* 1841, *for a new mode of producing a Black Color in Dyeing.

To all whom it may concern: Be it known that I, John D. Prince, Jr., of Lowell, in the state of Massachusetts, have invented, or discovered, a new and improved mode of producing a black color, in the operation of dyeing, by a combination of ingredients not heretofore employed in the manner, and for the purpose, discovered and adopted by me. The common mordant used in dyeing various articles of a black color is, as is well known, an acetate of iron; and the best effect of this mordant is obtained when, by the action of the air, a mixture, or compound, of the protoxide of iron is formed on the substance to be dyed. I have ascertained, by repeated trials, that the proto-sulphate of iron (copperas) may be advantageously substituted for the acetate of iron, as a mordant, by bringing it into that state which shall coerce it to deposite these two ingredients, the protoxide and peroxide of iron, on the goods under treatment. There are various articles which effect this purpose to a certain extent, but that which I found to do so in the most perfect manner, is the arsenious acid (arsenic) mixed, or combined, with the proto-sulphate. The proportions of the two ingredients admit of considerable latitude, but the following has been found to answer well. I dissolve one pound of copper in a gallon of water, and in another gallon of water I dissolve four ounces of white arsenic, and then mix the two solutions, which mixture constitutes my iron liquor. For the purpose of transportation it is desirable to obtain the ingredients from which the solution is to be made, in a dry state; for this purpose I take copperas and drive off its water of crystalization by exposing it to heat upon iron, or in any other convenient mode, and to the dried mass I add four ounces of white arsenic for every pound of copperas first taken, the whole is then reduced to powder, and may be readily converted into iron liquor by adding the proper quantity of water. The tendency of the protoxide, in copperas, is to pass too rapidly and completely into the state of peroxide, by which the object of obtaining a good black color is defeated, an injurious brown tint being produced. The arsenious acid has the property of preventing the peroxidation, and of inducing that state of mixed oxide upon which the perfection of the black is dependant, and this combination of arsenious acid, and its application to the purpose of producing a black color are, as I believe, entirely new. Having thus fully described the nature of my invention, what I claim therein, and desire to secure by letters patent, is the combining of arsenious acid with sulphate of iron, in the manner, and for the purpose, herein fully made known; and this I claim whether the two substances are mixed in a dry state, and afterwards dissolved, or whether the two substances be separately dissolved, and afterwards mixed together. Nor do I intend to limit myself to the proportionate quantities of the two substances herein stated as being generally used, but intend to vary these proportions within any limits which I may find to be advantageous." John D. Prince.

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